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December 9, 1937

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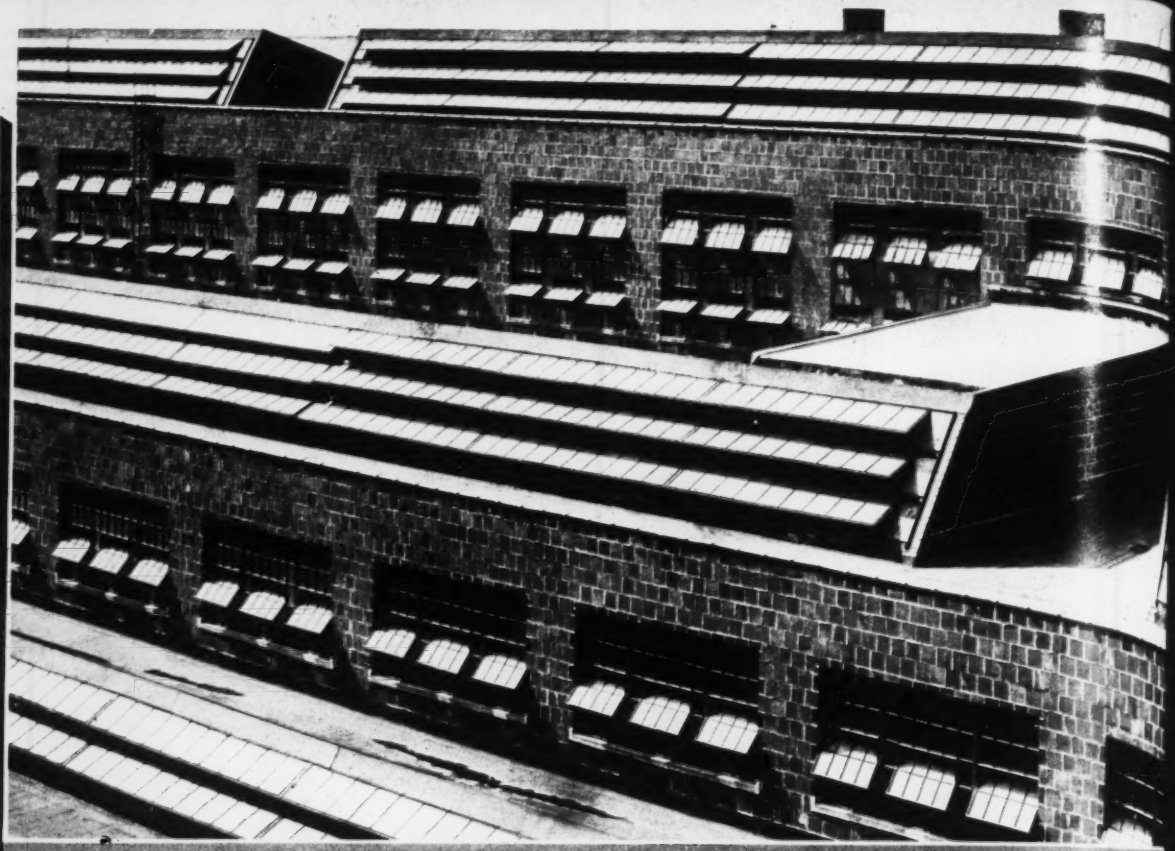

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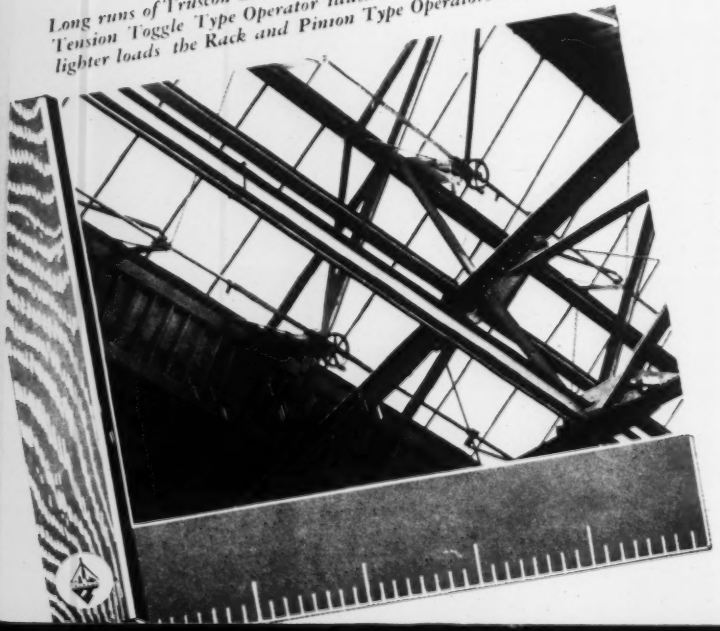

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One Budget Already Balanced

PRESIDENT ROOSEVELT has recommended that Congress cancel the 1939 authorization of $216,500,000 for federal highway aid. He would substitute an appropriation of about $100,000,000. This, he tells us, was about the average annual appropriation during the five years preceding the depression. Then he goes on to recommend that Congress "limit to not more than $125,000,000 per annum all public roads authorizations for the fiscal year 1940 and for each of the next few succeeding years."

Of course, this fine show of zeal in behalf of governmental retrenchment strikes a responsive chord with the part of the metropolitan press that parroted so monotonously for "a balanced budget" throughout the period when the nation was reeling into depression and when such a policy would have precipitated utter collapse. Already its "squander hounds" are again in full cry.

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ALTHOUGH it is not practicable to offer here a justification of the current highway program, which the President would upset, it is desirable to comment briefly on two aspects of the situation.

The first rises from the fact that federal aid appropriations must be matched by the states and expended through the state highway departments. Most state legislatures already have met and taken whatever action may be necessary to carry out the program enacted last year by Congress, and, be it noted, signed by the President. To cancel these authorizations arbitrarily, as now recommended by the President, would be an act of bad faith toward the states.

The second interesting aspect is the President's lecture on budget balancing. He says, "I do most strenuously object to the mandatory incurrence of obligations by the federal government under such apportionments without regard to its ability to finance them from its revenues." Apparently the President believes that the privilege of spending more than our revenues is an executive prerogative that does not extend to legislatures.

BUT let us take a look at the highway balance sheet. From the enactment of the first Federal Highway Act in 1916 through 1936 the federal aid expenditures have amounted to $2,079,086,000, including emergency relief and public works allotments.

But during the same period the federal government has collected from special taxes on highway users the sum of $2,252,487,000. Not so bad! In other words, at the end of the 1936 fiscal year, there stood to the credit of Uncle Sam a surplus of $173,401,000 which represents the excess of what he *took out* of the nation's highways over what he *put into* them. Since, in 1936 alone, the federal government thus realized a *net* revenue of $80,914,984 there is every reason to believe that the smaller appropriations made for 1938 and 1939 will be far more than covered by federal highway revenues. So it seems that in this matter of budget balancing, to which the President has become so zealous a convert, Congress has beaten him to it so far as highways are concerned.

The fact is, of course, that this high indignation of the President with respect to highway spending has little bearing on governmental economy or budget balancing. It is just another political move in the struggle between the Executive and a Congress that now is trying to resume its independence as a legislative body. This message is an effort to put Congress on the spot. In appraising its significance, both the members of Congress and their constituents will know how to discount its dubious recommendations.

Willard Chevalier

ENGINEERING NEWS-RECORD

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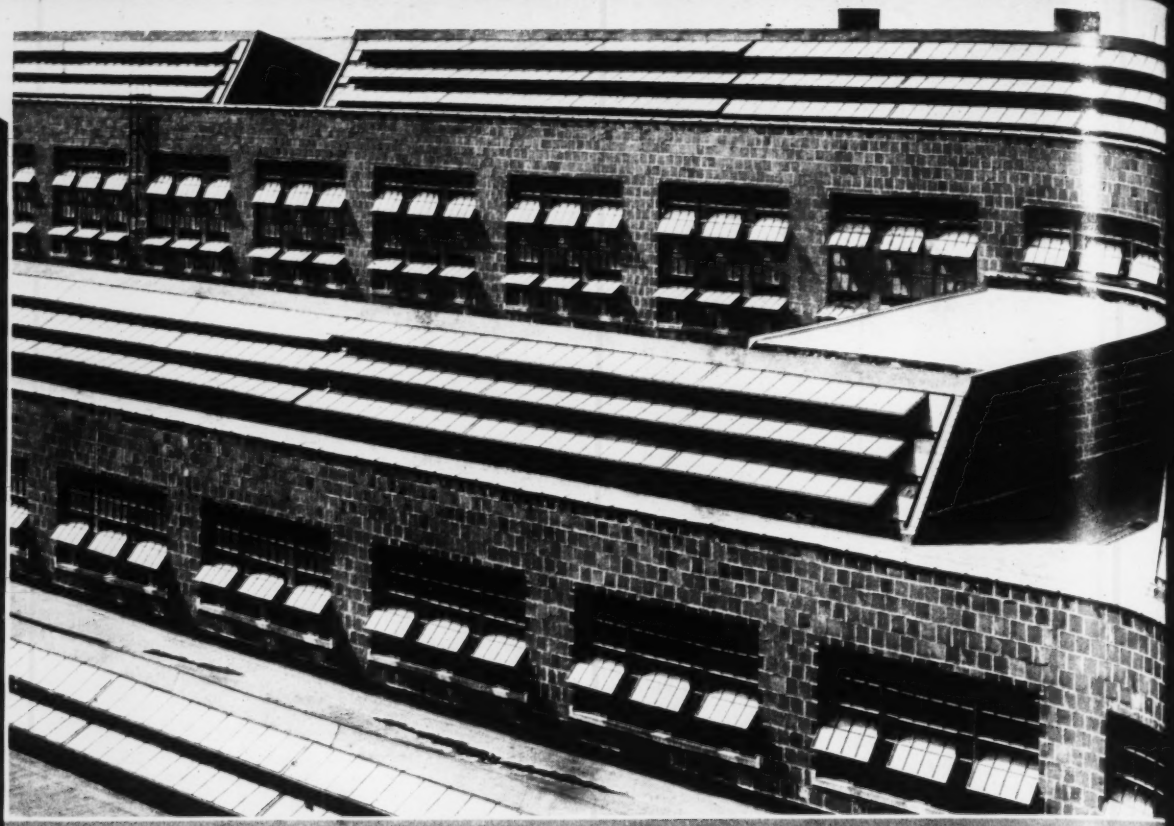

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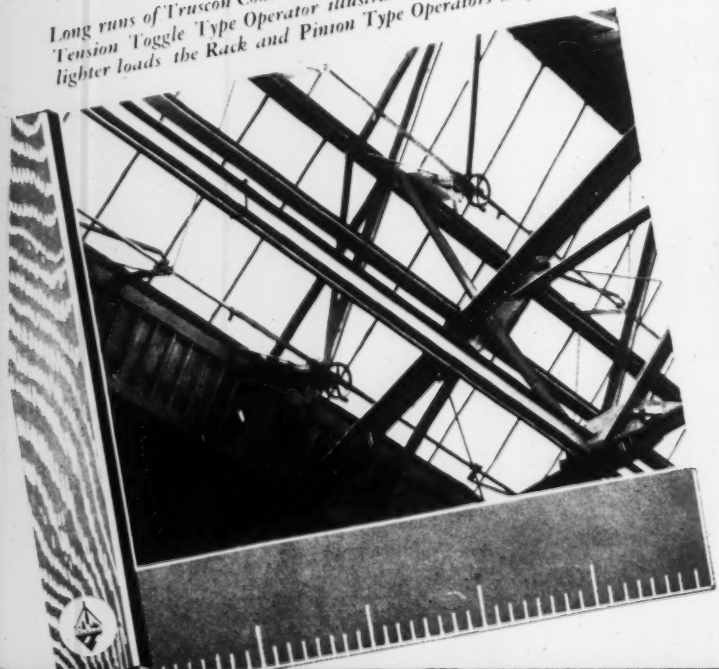

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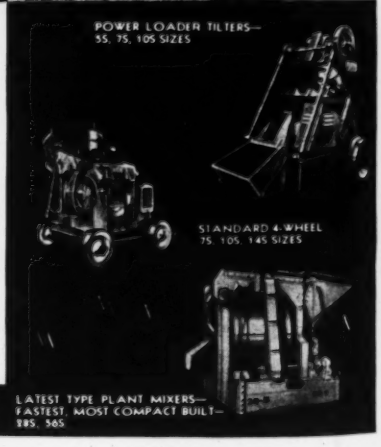

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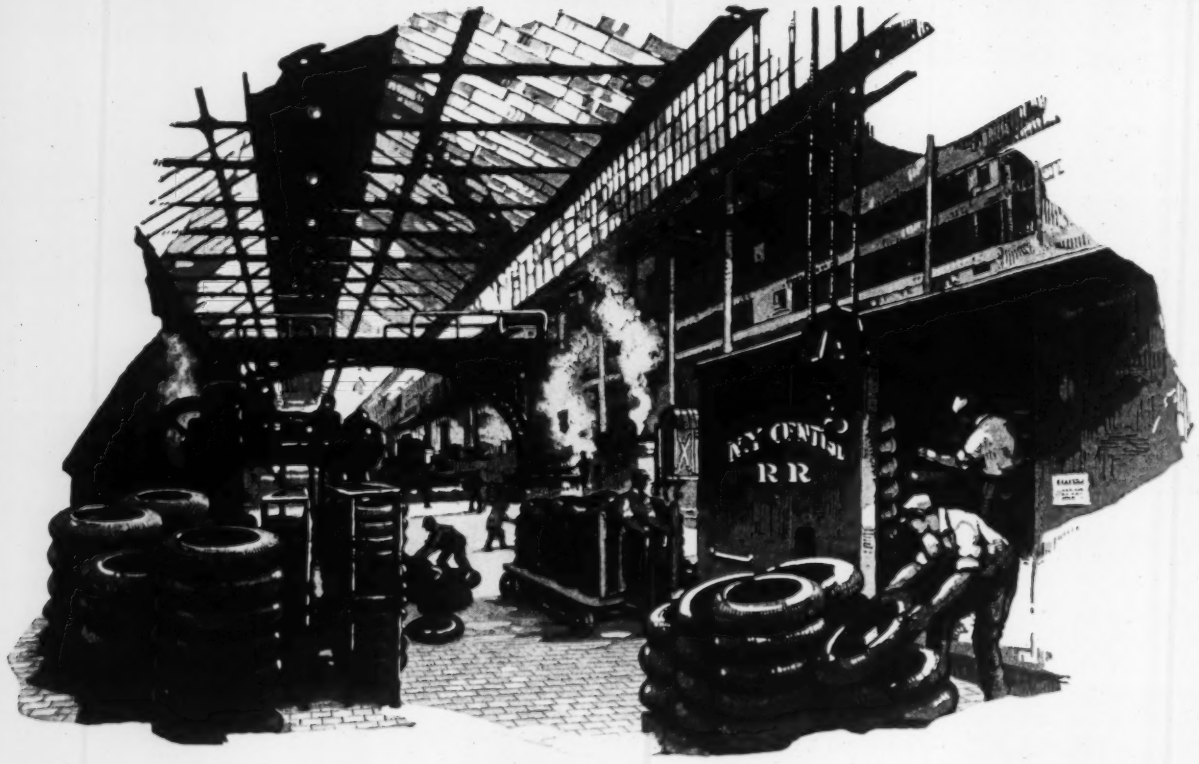

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F. E. SCHMITT, *Editor* ALBERT E. PAXTON, *Manager*

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VOL. 119 *DECEMBER 9, 1937* NO. 24

THIS WEEK AND NEXT

BUILDING has experienced a year of unusual achievement, so full of accomplishment in fact as to warrant devoting this entire issue to it. Among the buildings described are the:

Corning Building, a 6-story office structure on New York's Fifth Avenue which has windowless walls of glass block and uses twenty-six other forms of glass in its construction.

Research building of the American Rolling Mill Co. at Middletown, Ohio, in which the walls and roof are of steel sheet, the frame is welded, the non-opening windows are of glass block and plate glass and the exterior is porcelain enamel and stainless steel.

Hamilton Standard Propellers factory in which cantilever trusses provide bays 64 ft. square and in which mercury vapor lighting is used.

New school at Elkader, Ia., which pioneers in windowless glass block walls for educational buildings.

Marshall-Field Building in Evanston, Ill., whose roof is designed as a parking lot for customers' cars.

Glenn Martin aircraft building in Baltimore, where 304-ft. span trusses provide unobstructed floor space for assembling super Clipper ships.

Lincoln Electric Co. factory in Cleveland whose all-welded frame is characterized by rigid-frame sawtooth bents and by a high arch bay suggestion of auditorium practice.

Bendix Aviation Co. plant established on a country site in New Jersey and featuring all-welded cantilever trusses in bays 50 ft. square.

Johnson Wax Building in Racine, Wis., which defies description in a few words but contains reinforced concrete columns tapering down instead of up and incorporating flared capitals that constitute the roof slab.

BUILDINGS THAT EXPRESS NEW TRENDS

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ON THE COVER—Symbolic of the "new trend" theme of this issue and of the motive force behind the development of new trends is the research building of the American Rolling Mill Co. at Middletown, Ohio.

Number of copies of this issue printed: 31,396

No More *Marker Maintenance* *Expense!*

Atlas White pedestrian markers in Vermilion Street, Danville, Ill. City Engineer, L. H. Kirby; Contractor, R. McCalman, Inc., Danville.

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THE WEEK'S EVENTS

Court Upholds Tax On Federal Jobs

Supreme Court holds states may tax receipts of contractors on federal projects

State taxes imposed by West Virginia and Washington on the gross receipts of contractors doing work within those states for the federal government were upheld by the U. S. Supreme Court in three decisions handed down Dec. 6. The cases involved suits brought by the Dravo Contracting Co., builder of several dams on the Ohio and Kanawha Rivers against the State of West Virginia and by the Mason-Walsh-Atkinson-Kier Co. and David H. Ryan, contractors on the Grand Coulee Dam, against the state of Washington.

In each case, the state in which the work was performed has attempted to tax the receipts of the non-resident contractor, who has been refusing payment on the ground that he was acting as the agent of the federal government and that the tax would be, in effect, a tax laid upon the United States. The United States itself did not take this view, Attorney-General Cummings having held, in a brief filed last September, that despite the admitted fact that such taxation would increase the cost of federal operations, the United States could not logically object to a "non-discriminatory" tax which was not specifically aimed at federal operations.

No tax on government

In the Dravo case, the court first held that the United States did not have exclusive jurisdiction over the site of the work, basing this decision on the terms of the state legislation which permitted the government to acquire property within the state. The court then ruled that the mere fact that a tax on the contractors' receipts might tend to increase the cost of the federal government's operations, did not in itself render the tax a tax upon the government. Substantial and immediate interference with the operations of the federal government would have to be shown, the court ruled, before a state tax could be disallowed. In the present case there was held to be no such interference taking place.

The court, however, pointed out that certain parts of the work done by the Dravo Contracting Co. were performed at its Pittsburgh plant, and that these portions of the work were not liable to the state tax.

Jurisdiction an issue

In the cases involving the Grand Coulee contractors, the court accepted the arguments used in the Dravo case as to the validity of the tax, and held that the only question was whether the United States had exclusive jurisdiction. Pointing out that the state of Washington has been exercising regularly the normal functions of government in the Grand Coulee area, the court held that the United States did not have such jurisdiction. The tax was therefore upheld.

Aluminum suit upheld

In an opinion handed down the same day, the Court ruled that the United States may proceed with its anti-trust suit against the Aluminum Co. of America which was begun last summer. At that time a Pittsburgh court held that the new suit was invalid, since it would merely duplicate a suit brought in 1912 which was terminated by a consent decree. That ruling was reversed by a three-judge federal court, which upheld the government's right to proceed, and the Supreme Court has now ruled that the three-judge court was correct in its decision.

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Night Work Enjoined On Aqueduct

New York aqueduct contractor ordered to stop work at night because of noise

An injunction restricting work at the Palmer Ave. shaft in Yonkers, N. Y., of the Delaware aqueduct was granted Dec. 1 by the New York State Supreme Court. The court refused, however, to grant the demand made by residents in the vicinity for damages allegedly caused their homes by blasting at the shaft and also refused to limit the amount of dynamite which might be used for each blast. The New York City Board of Water Supply is building the tunnel to provide additional water for the city.

Nuisance created

In the testimony, residents had asserted that the noise of the excavation machinery had created a nuisance and that stones had been hurled great distances by the blasts. The Board of Water Supply asserted that the night work was necessary because of the danger of a shortage of water for the city.

"As to the blasting" the court ruled, "no evidence was offered regarding the size of the charges used or to prove that smaller charges could be used with less noise. . . .

"As to the dumping of material, no evidence was offered showing there was any other method of removing the material, and the sole question deemed presented relates to the hours during which that work is done.

"It is claimed that this night work is necessary because the need for the additional supply of water is urgent, but that claim is not borne out by the testimony. . . .

"The people in the locality must suffer inconvenience and annoyance of the operations during the day, but no good reason is shown requiring them to suffer the annoyance during the night. The dumping of the material should stop at 7 p.m., and after that hour and until 7 a.m. only such machinery should be operated as is necessary to lower men into the shaft and lift them out and to keep the air in the tunnel clear."

Four-Year Plan For New York

Regional Plan Association proposes projects in metropolitan area costing $340,000,000

Expenditure of $340,604,000 during the next four years on highway, railroad, and park projects in the New York metropolitan area is recommended in the third quadrennial list of urgent public works issued by the Regional Plan Association. Of the total cost, $143,717,000 would be for highway improvement, $177,400,000 for railroad projects and $19,487,000 for acquisition of park land.

The Regional Plan Association is a semi-public body which coordinates the plans of the various governmental units in the metropolitan area and makes recommendations to these bodies on the basis of its coordinated plan. Its recommendations have no legal force.

The metropolitan loop

Outstanding in the highway recommendations of the association are a number of steps to advance farther the highway loop around the more congested areas of the city. This loop already includes the West Side express highway and the East River Drive in Manhattan.

Recommended for immediate construction is an approach from the Creedmoor freeway in Queens to the Bronx-Whitestone bridge, on which construction will start soon.

Also recommended is a direct route to cross the Bronx from the Whitestone Bridge to the George Washington Bridge. This would involve a new bridge across the Harlem River. Construction of a new link to the loop in Queens is recommended, and it is suggested that studies be made of the best location for sections of the loop in New Jersey.

Early completion of a vehicle tunnel across mid-town Manhattan connecting the new Lincoln Tunnel and the Queens Mid-town Tunnel which is now under construction, is urged, as is construction of new links in the East River drive from 14th to 34th St. and from Grand St. south to South St., also in Manhattan.

A number of highway improvements are proposed in Queens, including an express highway connecting downtown Brooklyn and Queens and an express highway approach to the Queens Mid-town Tunnel.

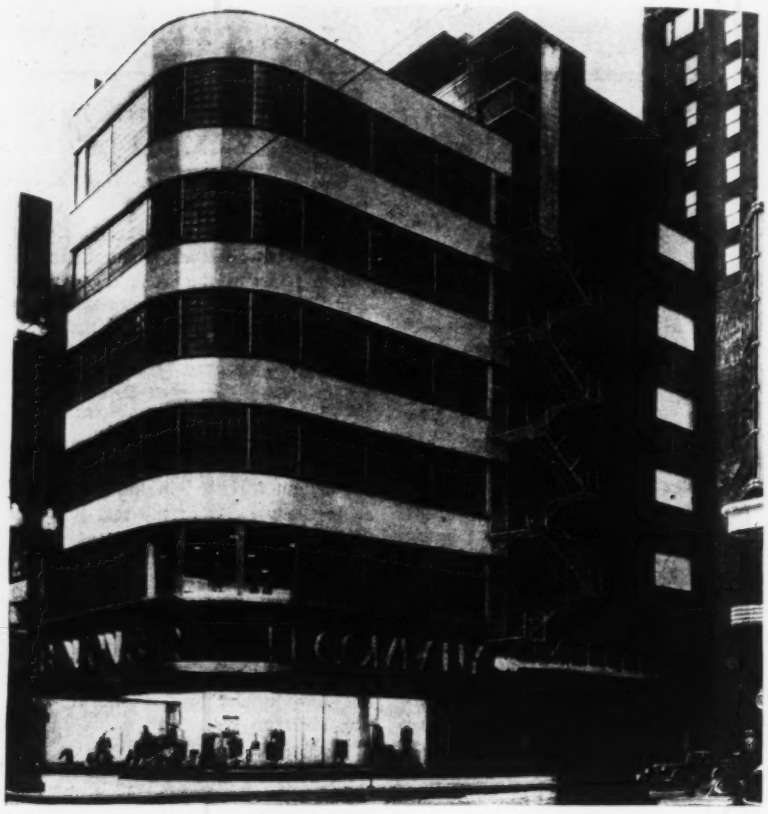
In the northern part of the area, it is proposed that the Bronx River Parkway be extended south through Bronx Park and along the lower Bronx River to meet the Triborough Bridge approach. The Eastern State Parkway, northern extension of the Bronx River Parkway, should be widened, and a highway should be built between New Rochelle and Portchester to relieve the Boston Post Road.

A southwest approach to the Lincoln tunnel across the Jersey Meadows is an outstanding recommendation in New Jersey.

Three railroad projects recommended include studies for a Greenville-Bay Ridge freight tunnel to connect Long Island with New Jersey railroads, studies for a New Jersey suburban rapid transit system including a tunnel under the Hudson River near 51st St. and extension of electrification on the Jersey Central, Erie and West Shore Railroads.

Acquisition of land for park purposes is recommended in a number of regions by the report. These include land along the top of the Palisades, on the north shore of Jamaica Bay, along the Merritt Parkway and the west end of the Long Island motor parkway, and additional parks in New Jersey along Newark Bay in Bergen County and along the eastern slope of First Watchung Mountain.

Steps towards carrying out a number of the recommendations in the plan were taken Dec. 8 when Parks Commissioner Moses proposed a program of inter-borough parkway construction to the city Board of Estimates.



MULTI-STORY GLASS BLOCK BUILDING

A MONTH after the opening of the Corning Glass Works office building in New York City, the first multi-story building to use windowless glass block walls, described in this issue, a building of similar construction was opened in Chicago for the Benson & Rixon Department Store.

This new building is enclosed in continuous glass block panels with black and cream glazed-tile spandrels and elevator shaft walls. An innovation is the use of special movable sections in the wall to comply with fire department regulations which require windows. These movable sections, designed by the architect, Alfred F. Alschuler, in collaboration with the Owens-Illinois Glass Co., consist of half blocks set in a side-hinged steel frame. When closed, the sections look similar to the rest of the wall. The movable sections may be seen above as the narrow panel at the left.

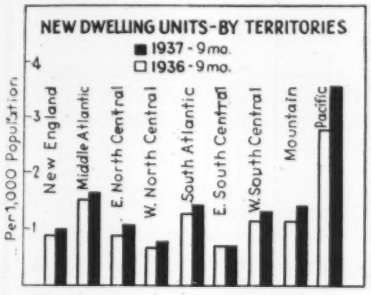
THE CURRENT TREND

This week's news of contract volume and construction cost factors

Urban Housing Increases

District of Columbia, Florida and California show highest per capita housing construction

New urban family dwelling units, built in the first 9 months of 1937, provide for 167,216 families. This is an increase of 13 per cent over the corresponding months of 1936. Distribution by states of this new housing, reported by the Bureau of Labor Statistics, is analyzed here by population density. It ranges in 1937 from 0.33 new dwelling units per 1000 population in North Dakota to 9.66 new dwelling units per 1000 persons in the District of Columbia. The average for the country is 1.36. The three Pacific States average 3.56, the four East South Central states average 0.71 new family dwelling units per 1000 population.



These figures are based on building permits reported by 1500 cities aggregating 59,000,000 in population, or 85 per cent of the entire urban population in the 1930 census.

All cities have increased the number of dwelling units provided except those having a population of 500,000 or more, and they have equalled the 1936 mark. In the other cities gains over 1936 range from 9 per cent in those having 100,000 or 500,000 population, to 31 per cent in those having 10,000 to 25,000 population.

One-family dwellings provide 71 per cent of the total, and compare with 66 per cent in 1936; two-family dwellings, 6 per cent, compare with 5 in 1936; and multi-family dwellings 23 per cent, compare with 29 per cent in 1936.

All parts of the country share the increase over last year except East South Central which equals its 1936 total. Pacific Coast states with 3.56 units for every 1000 population compare with 2.76 in 1936; Middle Atlantic's 1.63 units compare with 1.55; South Atlantic's 1.43 with 1.28; Mountain States' 1.41 with 1.16; West South Central's 1.33 with 1.17; East North Central's 1.03 with .88; New England's .98 with .90; and West North Central's .78 with .66 in 1936. District of Columbia's high of 9.66 in 1937, compares with 9.28 in 1936. California's 4.49 compares with 3.59 last year; Florida's 4.13 with 4.05; New York's 2.44 units per 1000 population compares with 2.46 a year ago.

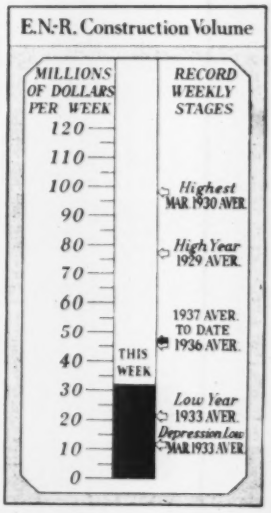
Business Briefs

FABRICATED STEEL PLATE orders totalled 373,914 short tons for the 10 months of 1937 compared with 392,554 last year, as reported by the Bureau of the Census. Oil storage tanks increased to 114,984 short tons compared with 84,414 a year ago, and refinery material and equipment to 33,466 compared to 31,916 in 1936. Gas holders dropped to 3,185 compared with 6,414; tank cars and blast furnaces, 10,946 compared with 25,190 last year; and miscellaneous 211,333 short tons compared with 244,620 for the 10 months of last year.

OCTOBER EMPLOYMENT in construction industries in New York State dropped 2.7 per cent from September. Payrolls decreased 3.2 per cent and man-hours 3.1 per cent. In New York City employment decreased 0.1 per cent; payrolls 3.0 per cent; and man-hours 2.1 per cent according to the New York State Department of Labor.

New Family-Dwelling Units in Urban Areas per 1000 Population
First Nine Months, 1936 and 1937

	1936	1937
United States	**1.20**	**1.36**
New England	**.90**	**.98**
Connecticut	.97	1.23
Maine	.46	.52
Massachusetts	1.02	.99
New Hampshire	.62	.83
Rhode Island	1.02	1.30
Vermont	.29	.39
Middle Atlantic	**1.55**	**1.63**
New Jersey	1.10	1.05
New York	2.46	2.44
Pennsylvania	.57	.81
E. North Central	**.88**	**1.03**
Illinois	.63	.64
Indiana	.45	.86
Michigan	1.16	1.78
Ohio	.95	1.04
Wisconsin	1.41	.97
W. North Central	**.66**	**.78**
Iowa	.55	.65
Kansas	.65	.78
Minnesota	.80	1.03
Missouri	.78	.86
Nebraska	.50	.67
North Dakota	.39	.33
South Dakota	.58	.53
South Atlantic	**1.28**	**1.43**
Delaware	1.21	.80
Dist. Columbia	9.28	9.66
Florida	4.05	4.13
Georgia	.60	.77
Maryland	.74	1.06
North Carolina	.77	1.01
South Carolina	.81	.74
Virginia	.66	.67
West Virginia	.57	.88
E. South Central	**.71**	**.71**
Alabama	.42	.63
Kentucky	.64	.58
Mississippi	.62	.70
Tennessee	1.13	.93
W. South Central	**1.17**	**1.33**
Arkansas	.37	.42
Louisiana	.82	.92
Oklahoma	1.04	1.15
Texas	1.62	1.84
Mountain	**1.16**	**1.41**
Arizona	.90	1.19
Colorado	.98	1.36
Idaho	1.48	1.48
Montana	1.09	.94
Nevada	2.31	2.78
New Mexico	1.38	1.55
Utah	1.23	1.85
Wyoming	.92	1.26
Pacific	**2.76**	**3.56**
California	3.59	4.49
Oregon	.81	1.72
Washington	.95	1.30



THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Dec. 10 1936	Dec. 2 1937	Dec. 9 1937
Federal	$12,567	$3,675	$5,280
State & Municipal	17,814	21,347	17,853
Total public	$30,381	$25,022	$23,142
Total private	28,863	16,658	8,731
TOTALS	$59,244	$41,680	$31,873

Cumulative
1937 (49 weeks) $2,312,143
1936 (50 weeks) $2,254,116

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	1936 50 Wks.	Cumulative 1937 49 Wks.
NON-FEDERAL	$924,137	$1,387,585
State & mun. bonds	490,910	477,740
Corporate securities	243,502	501,780
PWA loans, grants	164,727	178,186
RFC loans	24,998	29,939
Fed. aid for highways	.....	200,000
FEDERAL	$691,237	$746,223
TOTAL CAPITAL	$1,615,374	$2,133,808

ENR INDEX VALUES

Index Base	1913	1926
Construction Cost (Dec.)	244.95	117.75
Construction Volume (Nov.)	146	64

Road Research at High Level

Studies and experiments reported at meeting of Highway Research Board range from soils to safety, tire pressure and properties of asphalt, and roadside developments

SOIL PROBLEMS, roadside development and traffic safety were leading subjects of reports and discussions at the Highway Research Board meeting at Washington last week. The meeting continued through four days, this departure from the Board's customary two-day meeting being made because of growth in range of committee work and research activity. Thirteen technical sessions were crowded into the four days, in addition to a business meeting and the annual dinner; during some periods several sessions ran simultaneously.

William B. Stout, president of Stout Motor Car Corp., Detroit, addressed the dinner meeting with a forecast of greater development of automotive transportation. He intimated that many inventions and technical developments created during the depression still await favorable business conditions for commercial exploitation. He urged that traditional assumptions and habits of thought be not allowed to retard development, and suggested that housing, most backward of arts, is in need of finding radically new methods.

Soils and stabilization

Soil study occupied two group conferences during the entire first day of the meeting. In the one, specific cases of foundation and embankment design were presented for discussion, including bridge piers, cofferdams and embankments. The discussion brought out a wide range of opinion on soil action, principles of design, and suitable methods of investigating soil properties. The other group conference, devoted to soil stabilization, gave consideration to soil mixture grading, to chemical, bituminous and cement admixtures, and physical and electrochemical factors such as vapor pressure and alkalinity in stabilization.

Cement and bituminous stabilization were dealt with separately at a later session by W. H. Mills, testing engineer of the South Carolina highway department and H. C. Weathers, of the Florida highway department. South Carolina's trials of cement admixture to stabilize earth roadbeds have given excellent results at a low to moderate cost, and other states reported similar success. Bituminous cover coats or wearing surfaces were found desirable in most instances. In Florida, according to Mr. Weathers, bituminous treatment of local sand materials produced excellent roads for medium traffic use.

Roadside development was discussed with regard to both control of bank erosion and service to the traveling public by wayside park and planting areas. Strongly increased recognition of the fact that roads should be more than mere transportation devices and of the value of recreational development was evidenced in a number of papers and discussions. The flattened or "streamlined" cross-sections now coming into wide favor were given full attention as means of increasing safety, reducing maintenance costs and permitting proper care and beautification of the roadside. Control of access and roadside use was also discussed.

In a committee session of the subject, Prof. F. Aust, University of Wisconsin, summarized current efforts to extend erosion control by construction and planting; M. W. Torkelson of the Wisconsin Planning Board advocated county zoning for control of roadside uses; and W. H. Simonson, Bureau of Public Roads, reviewed progress in better shaping of right-of-way cross-sections. Prof. P. H. Elwood, Iowa State College, W. D. Ludwig, Pennsylvania highway department, F. W. Sayers, Missouri highway commission, V. J. Brown, *Roads and Streets*, and R. N. Bear, Soil Conservation Service, also contributed. Speaking from the maintenance standpoint, W. H. Root, Iowa highway commission, pointed out that, when erosion control has not had due attention in the design of the road, the maintenance forces can do much to correct conditions by modifying ditch grades and bank slopes, improving the soil, and fostering the growth of vegetation to stabilize the section. George B. Gordon, Bureau of Public Roads, emphasized the value of vegetation as a preventive of drainage and erosion troubles. E. D. Dryfoose and L. L. Allen, of the Illinois and Minnesota highway departments, discussed drainage methods in their states.

Many roads are becoming rural slums, said B. E. Gray, of the Asphalt Institute; development of parking places at small cost can help to remedy such deterioration. Clean-up in maintenance is also of value, according to J. J. Forrer, Virginia highway department. The pioneer work of Connecticut in developing parkway and landscaped areas beginning in 1928 received wide recognition. The later work of half a dozen other states in the same field was displayed by an interesting photographic exhibit held in connection with the meeting.

Much interest in safety

Road design and details were acknowledged to have direct bearing on road safety, in contrast to the past tendency to blame road accidents wholly on driver carelessness and incompetence. C. M. Noble, Port of New York Authority, and Joseph Barnett, Bureau of Public Roads, outlined research needs relating to safety in general and to sight distance determination. Discussion showed sharp difference of opinion as to the part played in accident causation by the road, the driver and the pedestrian respectively. A paper by Fred Lavis, consulting engineer, argued strongly for limiting road design to moderate speeds.

Subjects closely related to safety were brought out in a summary of skid resistance measurement methods by a committee headed by George E. Martin, Barrett Co.; description of a laboratory testing machine for skid resistance by E. E. Hanson, University of Minnesota; and a study of automobile curve action, especially wheel slip as related to oversteering and understeering, by Merritt Fox, General Motors Corp. Mr. Fox brought out that road design which produces more than 50 per cent "cornering" or side-slip effect is dangerous. A. B. Johnson, Goodyear Tire & Rubber Co., confirmed and extended Mr. Fox's results and showed that the cornering power of a car decreases with speed but increases with size of tire and inflation pressure.

Other safety or related papers dealt with license plate visibility, by Prof. W. H. Aldrich, University of Vermont; highway lighting, by Kirk M. Reid, General Electric Co.; patrol costs, by E. W. James, Bureau of Public Roads; accident-prone drivers, by H. M. Johnson, Highway Research Board; traffic regulation, by Prof. C. J. Tilden, Yale University; one-way streets, by W. S. Canning, Keystone Automobile Club; needed research in highway safety, by Roy W. Crum, director of the Highway Research Board.

Road economics

Highway accounting was reported on by Prof. A. Marston and R. Winfrey, Iowa State College. Highway economics was the subject of a number of papers: pavement life, by Robley Winfrey, Iowa Engineering Experiment Station; hourly traffic distribution, by W. A. Shelton, Bureau of Public Roads; tractive resistance, by Prof. H. B. Shaw, North Carolina State College; traffic speeds, by Prof. B. D. Greenshields, College of the City of New York; vehicle operating costs, by Prof. R. A.

Moyer, Iowa State College; and financial administration, by Thomas H. MacDonald, Chief, Bureau of Public Roads.

Mr. Winfrey discussed difficulties hindering the study of economic life of pavements. The records of the various states differ greatly as to the dividing line between construction and maintenance. Studies of traffic records for the Holland Tunnel and the George Washington Bridge at New York City by Mr. Shelton sought to determine what hourly, daily and monthly periods may be used in sample counts of traffic. Prof. Shaw suggested a third term in the formula for tractive resistance to compensate for the fact that track resistance increases directly with the speed of the vehicle, while air resistance increases as the square of the velocity. Mr. Greenshields made the suggestion that the average speed of vehicles using a highway offers a direct measure of its utility.

Mr. MacDonald brought out that four states now control all roads within their borders, and that a total of 172,000 mi. of road has been shifted from local to state control in 6 years, increasing state mileage by 64 per cent. About a quarter billion dollars of state motor vehicle money per year was distributed to local governments for roads and streets in 1936, though only nominal control is exercised by the states over the use of this money.

New facts on surfaces

Structural and engineering research resulted in a number of interesting contributions to knowledge. Vibration of pavement concrete was reported upon by several states; Prof. J. S. Crandell, University of Illinois, summarized French views. A small-chamber equipment for freezing tests was proposed by Prof. C. H. Scholer, Kansas State College. Prof R. W. Carlson, Massachusetts Institute of Technology, reported that early strength of cement pastes is directly proportional to early heat liberation. Studies of rattler tests on aggregates led D. O. Woolf, Bureau of Public Roads, to conclude that rattler results are accurate measures of the quality of aggregates, though discussion threw some doubt on whether the rattler does not give too low value for some types of stone. Brick filler tests on the road, reported by Prof. J. S. Crandell, showed two blended asphalts to be stable and non-exuding out of a large number of fillers tried. H. Z. Schofield, National Paving Brick Association, suggested that concentration of exudation of certain fillers over the base contraction joints is due to the kneading experienced by the filler at these points of movement.

Two important studies of asphalt were reported: a study of translucent asphalt films, by J. R. Benson and C. J. Becker, Kansas highway department, and tests of weathered against unweathered asphalt, by F. C. Lang, Minnesota highway department.

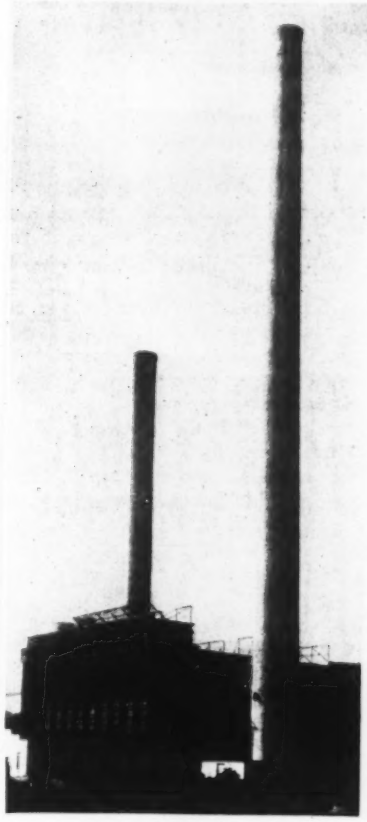
Benson and Becker examined 1/1,000-in. films under the microscope, and found that weathering influences, especially ultraviolet light, produce a structural breakdown revealed by progressive coagulation of the asphalt. Lang measured various properties of 23 oil asphalts before and after 22-hr. exposure to ultraviolet light. He concluded that a composite of impact resistance, abrasion resistance and ductility appears to indicate the value of the asphalt and that asphalts which give a positive spot test generally have low rating.

Asphalt stripping is being studied by a special committee, which presented a progress report.

Other research results were presented by Prof. H. J. Gilkey and associates, Iowa State College, on pullout tests of reinforcing bars; by L. W. Teller and J. W. Buchanan, Bureau of Public Roads, on distribution of tire pressure, which showed a roughly ellipsoidal distribution; by Prof. Inge Lyse, Lehigh University, on shear and bending strength of expansion joints, which showed large hollow dowels to be superior to small solid dowels; by Profs. M. G. Spangler and F. E. Lightburn, Iowa State College, on stress tests on concrete slabs, in which subgrade reaction measurements checked by direct rosette strains indicated some departure from the Westergaard formula; by Prof. M. G. Spangler on deflections of flexible pipe culverts, showing close approximation to thin ring action. A summary of facts concerning flexible pavement design was presented by A. C. Benkelman, Bureau of Public Roads.

Observations of the autobahn roads of Germany were presented by Prof. A. Casagrande, Harvard University, who told of making a 3-hr. run at average speed of 68 mi. per hr. Motion pictures of road systems in several states were also shown.

(A fuller technical report will appear next week—Editor)



TALL CHIMNEY

A POWER PLANT chimney 409½ ft. high, believed to be the tallest in the eastern United States, was completed recently for the Marion Reserve Power Co. at its Scioto station near Marion, Ohio. The chimney has an inside diameter of 14 ft. at the top. These dimensions compare with a height of 600 ft. and an inside top diameter of 25 ft. for the tallest chimney in the world, built for the Nippon Mining Co. at Chinnampu, Korea (*ENR*, May 27, 1937, p. 778).

The foundation for the Marion chimney is 8 ft. thick and 51 ft. in diameter and contains 465 cu.yd. of concrete and 25 tons of reinforcing steel. It rests on 310 wooden piles.

Segemental steel forms were used in construction of the concrete chimney, which is reinforced with vertical and horizontal steel bars. The design was based on a wind velocity of 100 miles per hour.

The chimney was built by the Rust Engineering Co. of Pittsburgh.

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Muskingum Project Slowed By Injunction

All operations except direct flood control work of the Muskingum Conservancy District were ordered stopped Nov. 3 by the directors of the district. The action was taken because of an injunction which prevented the district from issuing $1,500,000 in ten-year general levy bonds. The injunction is to be appealed.

The bond issue would have paid the cost of soil conservation, wild life propagation, recreational development, and other phases of the district's work. The injunction does not affect the flood control activities of the district, and, if it is upheld, future activities of the district will have to be confined to flood control.

Desist Order Issued On Metal Windows

Federal Trade Commission orders window manufacturers to change trade practices

Nineteen manufacturers of metal window products, comprising essentially all of the manufacturers and distributors of metal window products in the United States, and their trade association, the Metal Window Institute, have been ordered by the Federal Trade Commission to cease and desist from practices leading to the establishment of fixed minimum prices for the products of the industry.

Finding that the actual sales price of metal window products is determined by the corporations through the application of discounts to a gross or basic price listed in a book in general use throughout the industry or by the application of a formula contained in the book, the Trade Commission has ordered the companies to discontinue the practice of filing with the Metal Window Institute schedules showing the discounts which will be allowed from the basic price. Other practices which the companies are ordered to discontinue include the following: establishing minimum prices and uniform terms and conditions of sales; submitting estimates on a project in a given geographical area to the Metal Window Institute for the purpose of eliminating price competition in bidding; attempting by concerted action, including under-bidding and underselling, to induce a competitor to adopt schedules of discounts; and engaging in collusive bidding.

List of companies

The companies named in this order are as follows:

The William Bayley Company, Springfield, Ohio; Bliss Steel Products Corporation, East Syracuse, N. Y.; The Bougert & Carlough Co., Paterson, N. J.; Campbell Metal Window Corporation, Baltimore; Ceco Steel Products Corporation, Omaha, Nebr.; Crittall Manufacturing Company, Inc., Washington, D. C.; Detroit Steel Products Company, Detroit; Druwhit Metal Products Company, Los Angeles; Federal Steel Sash Company, Inc., Waukesha, Wis.

Michael Flynn Manufacturing Company, Philadelphia; Hope's Windows, Inc., Jamestown, N. Y.; Kewanee Manufacturing Company, Kewanee, Ill.; Mesker Brothers Iron Company, St. Louis; Michel & Pfeffer Iron Works, Inc., San Francisco; S. H. Pomeroy Company, Inc., New York; Soule Steel Company, San Francisco; J. S. Thorn Company, Philadelphia; Truscon Steel Company, Youngstown, Ohio; and Vento Steel Products Company, Muskegon Heights, Mich.

The Commission found that the Campbell Metal Window Corp. and Vento Steel Products Co. resigned from the Metal Window Institute in 1936 before the complaint was issued.

• • •

Highway Fund Cut Strongly Opposed

Strong opposition to any curtailment of federal funds for highway improvement was expressed at the opening session of the National Asphalt Congress now in session at Memphis, Tenn. The opinion was widely expressed that federal expenditures are not keeping up with growth of highway use and that a reduction to 1929 rate would result in a serious handicap to expansion of motor vehicle transport, would increase the accident toll and would greatly curtail the efficiency of the transport system. Thomas H. MacDonald, chief of the Bureau of Public Roads, said that the present trends are serious, that more mileage is being added to state highways systems while at the same time funds are being taken away. "Federal emergency appropriations," he said, "have obscured the serious effect of the transfer of funds to local agencies. If federal appropriations are curtailed, the state highway departments will be left short of funds for essential work."

Budget balanced

Willard Chevalier, President of A.R.B.A. and publishing director of *Engineering News-Record* emphasized the fact that the federal highway budget is more then balanced, that more funds are taken in through motor vehicle taxes than are spent on roads. He added that a balancing of the social and economic budget of the American people calls for more money for roads, not less. No federal money, said Mr. Chevalier, goes farther than road funds, because each dollar except those for grade crossings must be matched by the states. He also pointed out that expenditures of federal funds on grade crossing elimination and on farm-to-market roads represent a new federal policy since 1929, and should not be included when measuring present expenditures by those of 1929. Mr. Chevalier challenged the President's statement that we have a satisfactory basic network and have got the farmers out of the mud. Obsolescence has made it imperative that many miles of main roads be rebuilt, he said, and as to rural roads, nothing has been done to two-thirds of them.

Acid Sewage Damages Niagara Falls Plant

Gas fumes and acids discharged into the sewers from industrial plants in Niagara Falls, N.Y., have already caused serious damage to the city's new $1,400,000 sewage disposal plant, it was pointed out in a letter sent by George L. Watson, consulting engineer on the project, to the city council. The letter goes on to recommend immediate passage of an ordinance prohibiting the discharge into sewers of any waste of a liquid or gaseous nature tending to deteriorate the sewage plant structure and equipment.

The letter points out that in the six months during which industrial wastes have been taken into the plant serious structural damage has been done to concrete channels, in some cases eating away the concrete to a depth of an inch, and the metal work in the control structures is rapidly being corroded. On a number of occasions acid fumes from the industrial wastes have made it impossible to work in the bar screen room.

At the present time, wastes are merely being by-passed through the plant, which is not yet completed. Mr. Watson points out that if these wastes are permitted to go through the plant when it is in operation, serious damage to plant machinery and equipment can be anticipated. He states that he will not permit sewage to be turned into the plant until such time as the city is in a position to guarantee that it will not be of an excessively acid nature.

• • •

Florida May Not Enforce Cement Inspection Tax

A temporary injunction enjoining Florida state officials from enforcing a $3 per ton inspection fee on foreign cement brought into that state, was handed down November 26 by a three-judge special tribunal in federal court. The Florida tax was recently upheld by the State Supreme Court (*ENR* Oct. 21, 1937, p. 656).

Proceedings were instituted in Federal District Court at Pensacola by the Bimco Trading Co., a New York firm importing cement from Belgium and Denmark. The federal government intervened in the case on the grounds that the terms of the Florida inspection fee reduced the reciprocal advantages granted under the Belgo-Luxemberg trade treaty of 1935, whereby this country granted a 1½ cent per 100 lb. tariff reduction on Belgian and other cements in return for which those countries granted valuable customs reductions on industrial and agricultural products of the United States.

REAR ADMIRAL NORMAN M. SMITH

REAR ADMIRAL BEN MOREELL

Moreell Becomes Chief Of Yards and Docks

Commander Ben Moreell of the Navy Civil Engineer Corps was commissioned as Rear Admiral and became chief of the Bureau of Yards and Docks on December 1. He succeeds Rear Admiral Norman M. Smith, who is retiring from active duty at his own request.

Admiral Moreell who is forty-five years old, graduated from Washington University in 1913 and served for four years thereafter with the public works department at St. Louis as designing engineer and resident engineer on construction projects. Upon his appointment to the navy in 1917, he became assistant to the public works officer at the New York Navy Yard.

War service

During the war he was assigned as aide on the staff of the commander of the Azores detachment of the Atlantic fleet and also as public works officer of the U.S. naval base in the Azores. Then, after a year as civil engineer member of the plant board, he became principal assistant and executive officer to the engineer-in-chief of the department of public works in Haiti. Four years later he went to the Norfolk Navy Yard and in 1926 he became assistant design manager of the Bureau of Yards and Docks. His service in this capacity was interrupted by several years service in charge of an emergency construction program at the Puget Sound Navy Yard.

In 1935 he was made project manager of the shipbuilding and repair facilities of the storage and submarine base section and in August of this year he became public works officer of the Navy Yard at Pearl Harbor.

Admiral Moreell is well known throughout the civil engineering profession as an outstanding authority on concrete and reinforced concrete design. He is author of the widely used book, "Standards of Design of Concrete," issued by the Bureau of Yards and Docks.

Admiral Smith retiring

Admiral Smith, who is retiring at the age of 54, graduated from the Naval Academy in 1906 and after service as an assistant civil engineer with the rank of lieutenant, he attended Rensselaer Polytechnic Institute graduating with the degree of civil engineer. He then served in the public works department of the Naval Training Station at Great Lakes, Ill., and in various navy yards until 1917, when he became public works officer of the navy yard at Charleston, serving in that capacity throughout the war.

After service as public works officer in various naval stations, he became project manager of the Ordnance Establishment Section in the Bureau of Yards and Docks, holding that position for 3½ years. Then, after three years in charge of the public works department at the Boston Navy Yard, he was appointed chief of the Bureau of Yards and Docks with the rank of Rear Admiral in 1933.

• • •

David Coyle Nominated As A.S.C.E. President

David Cushman Coyle, consulting engineer, New York, has been nominated for president of the American Society of Civil Engineers under a provision of the society's constitution which permits 25 members to nominate any member by declaration. The official nominee for president is Henry E. Riggs, his nomination having been made by the board of direction at the time of the Boston meeting.

PWA Power Loans Before Court

Supreme Court begins hearings on loans to municipalities for public power development

Argument started Dec. 6 before the U.S. Supreme Court on the constitutionality of PWA loans and grants to municipalities for construction of electrical facilities competing with service already provided by private companies. The suits before the Court were brought by the Alabama Power Co. and the Duke Power Co. to prevent such allotments to the cities of Decatur, Hartselle, Guntersville and Russellville in Alabama, and to Greenwood County, South Carolina. The decision, however, is expected to control the disposition of a total of 52 similar projects to cost $84,026,288.

It is the contention of the utilities that the federal government is exceeding its powers by encouraging the construction of municipal utility plants through the provision of low-interest loans and outright grants. The result, they argue, is unfair competition and the destruction of their capital.

The government's answer is that the utility companies have no standing to challenge the validity of the allotments, since they hold non-exclusive franchises and municipal competition is admittedly lawful. Even if they do have a basis for the suits, the government contends, the loans and grants are justified under the general welfare clause of the Constitution as part of a general program to reduce unemployment through the stimulation of public works construction. The federal government, it is argued, exercises no coercion upon local governments either to accept PWA allotments or to utilize them for the construction of electrical facilities. The decision as to the type of project to be built rests entirely with the local government, subject only to the requirement of PWA that its loan must be well secured.

The issue has been presented to the U.S. Supreme Court twice before, but has yet to be decided. Once the court, in a case involving Allegan, Mich., refused to grant a writ of certiorari, and later, in the Greenwood County case, it ordered a retrial in the lower court because of technical irregularities. District Court decisions in PWA power cases have favored the government in 18 cases and have upheld the utilities in five. Five different Circuit Courts of Appeals have ruled in favor of the government, while none have upheld the utilities.

News Continued on page 961

ENGINEERING NEWS-RECORD

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Editor, F. E. SCHMITT · *Editorial Staff*, V. T. BOUGHTON
N. A. BOWERS, W. G. BOWMAN, W. W. DE BERARD
C. S. HILL, H. W. RICHARDSON, E. J. CLEARY

Editorial Offices at 330 West 42nd Street, New York

DECEMBER 9, 1937

DEFINITION: Building is a type of construction that costs too much. The President, in his housing message to Congress last week, restates this well-known fact and asks again what can be done about it. This issue, devoted to some of the new buildings of the year, emphasizes one attack on costs, namely the development of new competitive materials. In residence construction, where lower costs are most necessary, this normal method of reducing costs—through competitive new products—has so far made little headway. One reason lies in the high financing charges that housebuilding must absorb, charges so high that any possible reduction in materials costs goes unnoticed. Another obstacle is the method of distribution used for building materials and equipment, which boosts the cost to the final purchaser unnecessarily. Financing and selling costs are problems of management that no amount of product development and improved construction technique can overcome. When these costs are reduced to reasonable proportions, housebuilding may be able to reflect the economies of new materials and methods. Until then the definition of building given above will continue to apply to housing.

New Objectives

ROAD RESEARCH is shifting its attention from the numerous problems of pavement construction, which for years dominated the proceedings of the Highway Research Board, to soils, safety and roadsides. The chief reason lies in the very fact that pavement questions have been so much discussed in the past. The road is more than pavement; it extends across the whole right-of-way and down into the ground to the lowest level of active drainage processes. And further, it is not only a structure but also an operating facility, so that traffic has much to do with right planning and design. The roadside includes shoulders, ditches, slopes, the trees and posts that have brought death to many an unwary traveler, the parking area along the side, and in due course also the sidewalk. This wide extent of territory has had little consideration in analysis or research, but now that the road scientists are giving it attention it should see improvement. Soil problems are of even broader importance, not only because they concern the road subgrade and the construction of stable and solid fills but also because they give the key to low-cost road possibilities. If the two million miles of unsurfaced road are to see much improvement, soil study will have to show the way.

Saner Views Gain Ground

BY GENERAL CONSENT airplane wrecks are charged to weather conditions, defects of equipment, and the inherent hazards of flying. We do not often blame the pilots. Quite an opposite view has prevailed in the matter of road accidents, in part for temperamental reasons and in part because "repeaters" prove that in some cases a personal factor is present. This prevailing view has unfortunately turned attention away from the hazards of vehicle and road. Little thought has been given to the blind spot that conceals an overtaking vehicle, or to road conditions that make precise tracking difficult or that require ultra-rapid decision at intersections and other danger spots. Highway engineers and students of road problems shared in this neglect. But the discussions of last week indicate a change in thinking. The dangers of the vehicle are already under study and measurement; the dangers of the road also are beginning to be recognized, and may soon be put under the researcher's microscope. As the investigative work proceeds, safer roads will become possible, and the progress towards safety made in recent years will be accelerated.

Politics and Housing

AN INELEGANT spite fight inspired by the mayor of New York against Nathan Straus, administrator of the U. S. Housing Authority, has resulted in the resignation of the chairman and counsel of the New York City Municipal Housing Authority. The mayor disagreed with the policies of his appointees. The mayor forced them out. This simple chain of events and the details thereof have only local importance, but the precedent that the mayor's action establishes is of wide concern. Are municipal housing authorities to be non-partisan administrative bodies or are they to be political puppets? If the latter, we are setting up in public housing one of the most potent vote-getting and patronage vehicles that can well be imagined. As a corollary, inefficiency is being invited and the success of the program, both as a humanitarian and a business enterprise, jeopardized. If state housing laws do not already contain provisions that insure the municipal housing authorities reasonable protection from political sniping, some immediate thought should be given to revision.

Build to a Plan

ECONOMY WILL GUIDE public expenditure for years to come, as anyone may read out of the day's budget and debt figures. The proposal to cut road expenditures to the bone, as advanced in the President's message a week ago, brings this fact forcefully to attention. But at the same time it emphasizes the fact that mere budgeteering cannot serve the ends of economy, and that planning to a definite program is necessary. Small expenditures that fail to produce any useful effect may be wasteful.

Some aspects of the proposal to check road development were discussed in this column last week. The problem of a definite program to serve both road needs and economy remains to be considered. What policy shall shape the future of our road transportation system? It is known that a nation's industrial and economic strength is closely related to the efficiency of its transportation, and it is known also that in the United States today the road is an essential element of transportation. Maintenance of road efficiency therefore touches the personal interests of all.

That a program is necessary for wise direction of our vast undertaking of road modernization needs no proof. It is equally obvious that such a program must be based on facts. Up to the present our national road improvement has been a relatively simple task, since the hard-surfacing, straightening and widening of our main routes was the obvious primary need. For the future, however, so simple an approach to the problem is no longer adequate. A plan based on knowledge is required.

During the past few years road work has been extended into new fields by adding secondary roads and by starting on the huge task of making the grade crossing safe. Improvement here as well as in the field of main roads is as necessary this year and next as it was ten years ago. But the road has been outdistanced by growing traffic needs, and in consequence the problem today is so complex as to defy solution except on the basis of measured facts.

Fortunately, the needed facts are already being gathered. Federal and state road-service surveys begun a year ago are determining by precise methods the amount and distribution of traffic as well as the requirements of every type of traffic and every class of the population. Results are beginning to accumulate, and while full data will not be at hand for many months more it should soon be possible to draft tentative programs in many states. Within a year or two, if the studies are pursued with energy, we ought to have a plan for a comprehensive, efficient and safe road transportation system. On the strength of such a plan it will be possible to say in reasonably definite terms what yearly expenditure will permit of carrying the program forward purposefully. Federal and local budgets can then be shaped accordingly.

Present knowledge affords much less definite guidance. Yet existing conditions justify some significant conclusions. Even today it is possible to say that the initial undertaking to eliminate the deadly grade crossing should be continued at undiminished rate and that many secondary roads should be made passable for regular traffic, while at the same time the shortcomings of our main-road net work, which are even greater today than ten years ago, call for remedial action at least proportionate to that of the past decade. If the well-tested federal-aid system is to be preserved, a federal road budget of two hundred million dollars as established by the Hayden-Cartwright Act is therefore far from excessive.

But while present knowledge permits of approximating the needs of road transportation, effective plans and budgets await the completion of a program based on road-service facts. The countrywide measurements and analyses now in progress will determine both the future of our road development and the national interest which it involves.

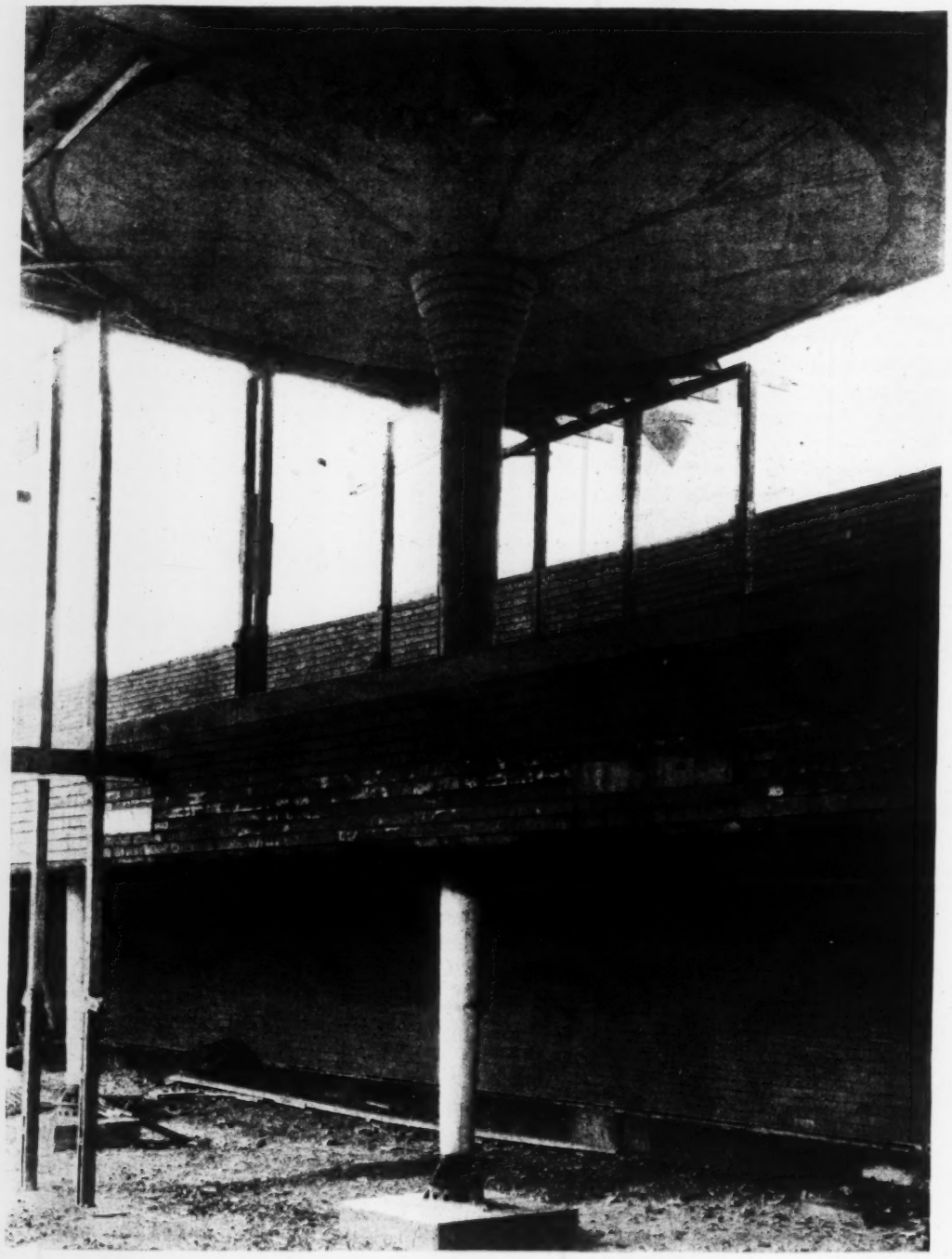
Quiet, Please!

CONSTRUCTION WORK is notoriously noisy. Must this be so? Is that incessant banging, chattering booming racket an indispensable by-product of construction activity? Since time immemorial it has been so regarded by builders. A long-suffering public is beginning to believe otherwise, however. An injunction against a Delaware River aqueduct contractor prohibiting night work in a residential community is a sample of the public's current temperament.

Like it or not, constructors must realize that outsiders have certain rights to peace and quiet—rights that will be preserved by legal means if necessary. Certain construction operations and some types of equipment are inevitable noisemakers, and little can be done about it but to do away with them—or, better, arrange the working schedule to cause a minimum of inconvenience and annoyance to neighbors. Yet most operations and many more kinds of equipment than at first might be realized are susceptible to noise reduction.

We are apt to boast of the speed, efficiency and economy of our modern construction tools; might inventive and design genius not be turned also to the fourth quality, quietness? Many constructors are proud of their fast production, their safe and efficient methods and their construction excellence. Why not add noiseless operation to this list of achievements? Let's devote some of the industry's ingenuity to noise elimination, and gain the public's goodwill to an extent heretofore unknown!

PICTURES IN THE NEWS



INTRODUCING THE "MORNING GLORY" COLUMN. Creation of Architect Frank Lloyd Wright, this unprecedented reinforced concrete column and its spreading hollow "petal" constitute the principal framing element in a new office building for the Johnson Wax Company at Racine, Wis. Reinforcement is expanded metal mesh. The upper part of the shaft is hollow.

AN INTRODUCTION TO

Buildings That Express New Trends

by WALDO G. BOWMAN
Associate Editor, Engineering News-Record

NO BRANCH of construction is so continually in the limelight as buildings. Since everyone sees buildings daily, works in them and makes his home in them, this is not surprising. But they have a further claim to fame, for in boom periods they lead the construction parade and when times are not so good they are being called upon to lead it.

Right now building is being blamed for its failure to respond to some of the roseate prophecies made in its behalf a year ago. Without doubt the effect of building construction on business improvement has been disappointing. On the other hand, some types of buildings have done all and more than could reasonably have been expected of them. And most of the other types have shown a steady if slow growth under handicaps.

This is the picture from the economic side. It is composed of highlights and shadows. It is good or bad depending upon one's viewpoint.

On the technical side, however, there is no room for quibbling. Advance has been definite, continuous and noteworthy. The results are everywhere about us in new mass effects, new color schemes, new framing arrangements, new uses for old materials, wide use of new materials and improved methods of heating and lighting. Architects and engineers have made the past year a high spot in building design, and builders have translated the plans into structures that set a new pace.

This issue is devoted to presenting some of these accomplishments as Buildings that Express New Trends. The precisionist might assert that most of the buildings cited do not express but merely suggest new trends. But whether or not the new features that they inaugurate develop into trends, they are for the moment important and significant in that they indicate a healthy disregard for precedent and a will to put to use the fruits of science and research.

In this respect a glance at some of these developments is enlightening.

Walls, for example, are being successfully built of pressed steel sheets and of cement-asbestos sheets, products of the laboratory. Insulation, another product, makes such walls possible. Then there is the phenomenal spread of the use of glass block, which research has made into a practical construction material with unique advantages. Porcelain enamel steel in color, windowsills and copings of stainless steel, brick in blending shades, are making polychrome effects possible. Improved technique in building architectural concrete walls is at the root of another type of wall improvement.

Building frames, too, have responded to the urge for improvement. Particularly is this true in the industrial structure where larger bays, valuable savers of floorspace, are being made possible by the use of cantilever trusses. Or, when an entire absence of interior columns is desirable, simple trusses in sizes uncommon to buildings are resorted to. A particularly noteworthy development is the adaptation of welded rigid-frame bents, eliminating trusses entirely. In riveted construction such frames have been used in Europe for a good many years. The first example in this country was the Continental Can Co. plant in Elwood, Ind., in 1935, and this year the design was extended to sawtooth roof bents in a building for the Lincoln Electric Co.

In many respects, the most unorthodox framing of the year occurs in reinforced concrete, in the new Racine, Wis., office building built for the makers of Johnson's wax. An extreme example of "form follows function" design, the building contains circular columns that increase in section from bottom to top and at the top flare into capitals that constitute the roof slab.

New developments in roofs keep pace with those made in other elements, while the interiors of the buildings reflect such other research-engendered changes as acoustical ceilings, accommodations for air-conditioning ducts, high intensity artificial lighting, cellular steel floors that give wiring accessibility new meaning and concrete floors that act as radiators.

And why this shift from old paths to new? Not to create bizarre effects nor to satisfy whims for sensationalism were these new buildings built, but rather to promote efficiency. Better light, better air, more unobstructed space, less dirt, decreased maintenance were among the objectives sought. In the following pages nearly a dozen of these new structures are described. All of them "express new trends" and lend credence to the view that the past year has been one of exceptional advance. They furthermore suggest clearly, in their discarding of entangling alliances with tradition, some of the coming tasks in the building field.

Twenty-Seven Forms of Glass

Office building of Corning Glass Works in New York presents a 4-story glass block wall to Fifth Ave. and an interior outfitted with glass products in many forms

THE "building of the year" on New York's Fifth Ave. is the new 6-story Corning Building whose windowless walls of glass block mark the first use of this new product in a multi-story city office structure. Distinguished further by over twenty other glass products used on the interior, it offers the architect and engineer a full size demonstration of what an old material made new by research offers the building industry. In the new building, which is also completely air conditioned, are housed the offices and show rooms of the several divisions of the Corning Glass Works. The building was completed in September.

The discard of conventional materials in the new building for products of glass is striking in the extreme. In the outside walls the glass building units replace limestone, brick and plaster; in interior partitions smaller size glass block are used instead of hollow tile and plaster. Wood and metal is replaced with glass for molding. Glass wool or fibrous glass is used in the wall expansion joints, as filter material in the air conditioning plant, as insulation for hot and cold water pipes, and, in tile form, as acoustical ceilings. Radiator grilles are of solid glass rods, and hollow glass rods and disks comprise the stairway balustrade. Plate glass doors, illuminated glass panels and grilles, Carrara glass toilet partitions, polished wireglass windows in the air conditioning plant, glass trim for doors, glass picture frames, glass neon tubing, glass screws and bolts and silvered glass tile in the entrance lobby are among the other glass products which add up to a total of **24.**

The Corning Building, as it is officially named, is 27x100 ft. in ground dimensions and is located on the corner of 56th St. and Fifth Ave. Six stories high, the building is enclosed on its street faces by screens of glass block four stories high framed in Indiana limestone as indicated in Fig. 1. Shops and display space occupy the first floor and part of a mezzanine while the rear of the mezzanine and the four upper floors are devoted to offices. Elevators for the latter are located in the rear of the building with an entrance on 56th St.

The 3,800 blocks that are used make up about 80 per cent of the exposed wall faces. The glass wall surface is divided into panels by 1,300 ft. of extruded nickel silver trim. Including 4,136 lb. of nickel silver for interior doors and trim, a total of 7,776 lb. of this material, an alloy of nickel, copper and zinc, is used in the building. The framework of the building is of steel arranged in six bents of 24 ft. 8 in. span; rolled sections are used throughout. Floors are of concrete in a 2-way slab of precast-slag block and poured-joist type.

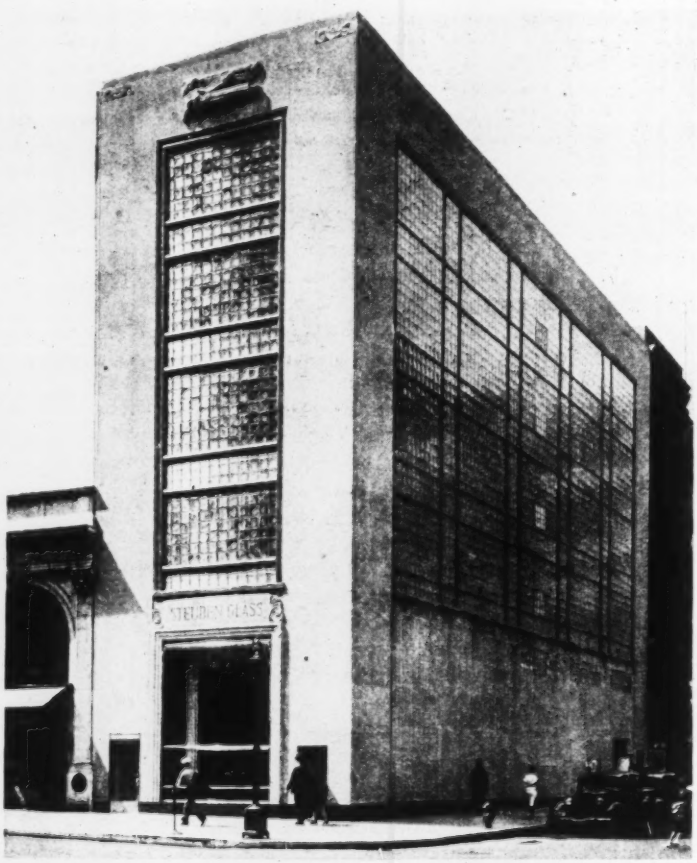


Fig. 1. First "main street" office building to use windowless glass block walls is this New York home of Corning Glass Works. Nickel silver trim outlines spandrels and pilasters.

Glass wall units

The wall block are made of Pyrex glass whose coefficient of expansion, 0.0000032, is about half that of steel. A large size block —1-ft. square—was adopted to reduce the number of units to be handled and

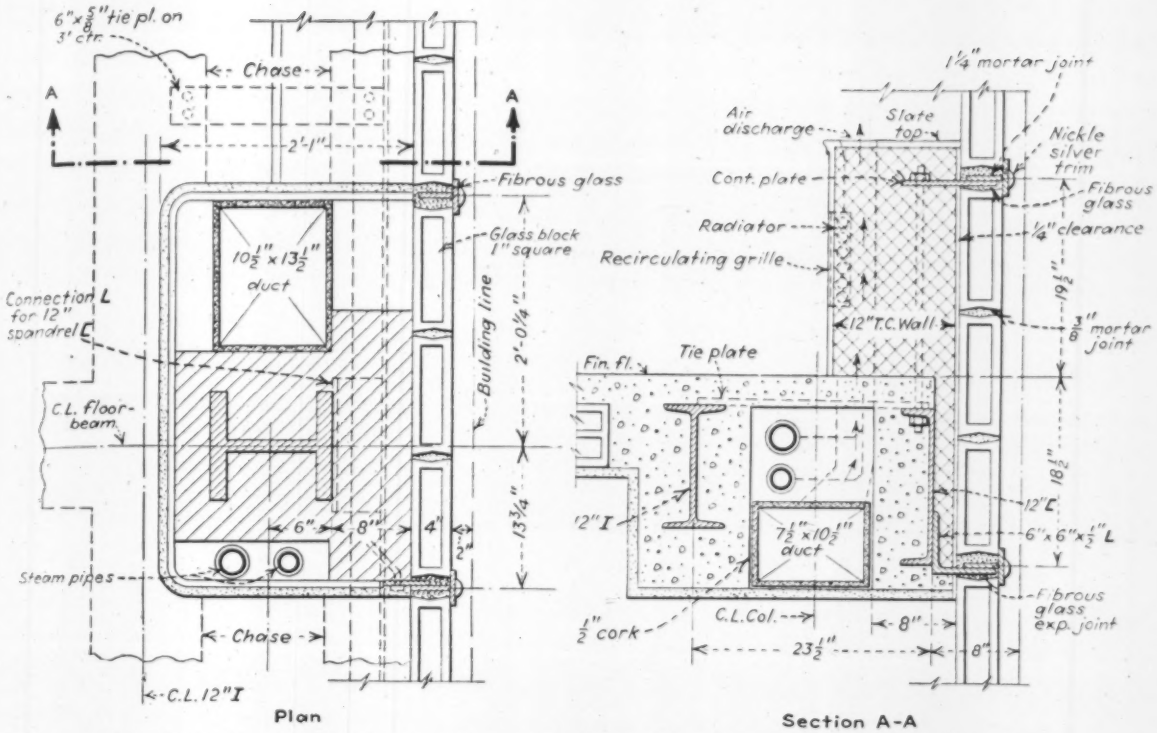


Fig. 2. Structural details of walls and air conditioning and heating facilities in the Corning Building.

also the number of mortar joints required. Fewer mortar joints mean fewer chances for leaks, and in addition transmission of light striking a wall at an angle away from the horizontal is greater for the large units than for small units where the larger number of joints interfere.

Each block is manufactured by fusing the edges of two glass "pans" together under pressure at a temperature of 3,600 deg. F. Fluting on the inside surfaces is placed horizontally on the front face and vertically on the rear to insure diffusion of light and obscure images behind the block. This arrangement of fluting also eliminates any lens effect. The edges of the units are scored and are made concave to insure bond and retention of the mortar at the joints.

The unit is said to transmit 78 per cent of the light directed at a surface, compared to 90 per cent for first-quality plate glass. As a corollary, however, light coming through a block is only about one-eighth as bright as when viewed through plate glass. And, because of the fluting, the light is diffused and scattered so that no sharp shadows result. The insulating value of the block is measured by the fact that it transmits only 40 per cent of the radiant heat falling upon it. Stated in another way, the blocks have a heat transfer value of 0.5 B.t.u. per sq.ft. per hr. per deg. F. temperature difference compared with 0.6 B.t.u.'s for an 8-in. brick wall.

Fig. 3. Expansion joints between glass block wall panels and the steel frame were packed with fibrous glass and sealed against moisture on the outside.

It is also claimed that the spacing of the faces is such that the resonance frequencies of the block lie outside the frequency range of usual noises. Over a frequency range of 120 to 3,500 cycles per second, experiments have shown a maximum loss of 42.9 and an average loss of 33.3 decibels. Test panels cemented with a 1:1:3 cement-lime mortar have successfully withstood the New York State standard fire test. The compressive strength of a single block is about 2,600 lb. per sq.in., and panels 4 blocks high by 3 blocks wide show a strength slightly in excess of 1,000 lb. per square inch.

Wall construction

The interesting features of the glass block wall construction in the Corning Building relate to the means of providing for differential temperature movements between the wall and the steel frame, to the methods of supporting the wall panels on the steel frame and to the compromises

in design made necessary by city building regulations. In each of these features, the building is unique.

One of the first considerations in the design was the necessary provision for temperature movements. Since the glass has a coefficient of expansion only half that of steel, positive physical separation was necessary. Logical wall panel limits were the undersides of the floor vertically and the faces of the column pilasters horizontally, or about 10x20 ft. Such a panel resting on the steel framework at the base is left free at the sides and the top, and the resulting joints are packed with fibrous glass. The exterior and interior faces of this extremely simple expansion joint are sealed with a calking compound and, on the outside, the joints are covered with the nickel silver strips which are screwed to steel tee sections inserted in the joints. Separate, tall narrow panels are used along the columns of the pilasters.

The outlines of these wall panels and the locations, therefore, of the expansion joints are clearly indicated on the face of the building by the nickel silver strips. It will be noted that there are two horizontal strips about 3 ft. apart at each floor level. At only one of these, the bottom one, is an expansion joint located. The other strip merely defines the top edge of the spandrel section in which blocks different from those used in the balance of the panel are installed. This difference consists in the use of narrow closely-spaced fluting which makes the brick spandrel masonry backup, required by building regulations, invisible from the outside. Similar block are used for the column pilaster panels.

Code requirements met

The code requirement of a 3-ft. masonry spandrel section is a fire-safety provision based on the use of ordinary windows, it being contemplated that flames escaping from a lower floor cannot reach the next story above. Based on the strength and fire resistance of the glass block, the designers claim that an 18-in. spandrel section is adequate when glass block construction is used. Another fire safety requirement resulted in the use on each floor of translucent glass panels that may be opened to admit fire hose or to permit the escape of smoke. These panels are visible on the 56th St. face of the building in Fig. 1.

Details of the method used to support the glass block wall panels on the steel framework are shown in Fig. 2. The fact that the building code called for 8 in. of masonry fireproofing in front of the wall columns proved to be somewhat restrictive from the standpoint of securing the extremely accurate level of steelwork support required for the glass block construction. With the center of the glass block wall 10 in. out from the column face extreme care in fabrication and erection of the steel was necessary to prevent twisting and warping. The detail consists of a 12 in. spandrel channel to which is riveted a 6x6x$\frac{1}{2}$ in. angle on which the glass blocks rest. The channel is rigidly connected to the columns by a 6x6x$\frac{7}{8}$ in. top angle and an 8x6x$\frac{7}{8}$ bottom angle. Between columns additional support is provided by tie plates whose back end is riveted to the longitudinal floor girder which is set about 1 ft. in from the column centerline. Except for this detail the steel framing is very simple.

Another major item of interest in the building is its air conditioning layout. Two systems are used, one for the shops on the first floor and mezzanine and the other for the four office floors. All air conditioning equipment is installed in a penthouse on the rear of the roof, fresh air being admitted through louvres on the north exposure. Heating is by steam through fin-type radiators over which the fresh air is blown at the duct outlets in the rooms.

Fig. 4. Large-size glass wall units, 12x12x4 in. were laid up in $\frac{3}{8}$ in. mortar joints by brick masons.

Air conditioning plan

The general scheme of air distribution is to bring the main supply and return air ducts through the roof slab into a space above a suspended ceiling on the fifth floor and there to attach branches leading to each of the column lines. The ducts then feed down to the various floors at each of which they branch horizontally to an outlet in an air mixing cabinet set in the center of the wall panels. The vertical ducts run in the column furring and the horizontal ducts (as the floor levels) in chases in the masonry spandrel walls. Ducts for the stores are brought down in the same way but terminate in a series of branches located above a suspended ceiling over the first floor mezzanine.

As stated, steam heating is used with the air conditioning system in the winter. Steam pipes rise in chases along the columns and branch at each floor to the fin-type radiators installed as part of the air mixing cabinets in the spandrel walls. The air discharge passes over these radiators and through grilles into the rooms thus providing efficient circulation. In summer, cooled air is discharged through the same grilles.

Viewed from the inside of the building, the grilles are the only evidence of the air conditioning installation since all duct and pipe work is enclosed. A strip 2-ft. wide around the building and about $2\frac{1}{2}$ ft. above each floor is required for this installation.

The Corning Building was designed by William and Geoffrey Platt and John M. Gates, associated architects, New York City. Syska & Hennessy were the mechanical engineers, H. G. Balcom, the structural engineer, and Marc Eidlitz & Son, Inc., the general contractor. Post & McCord fabricated and erected the steel frame.

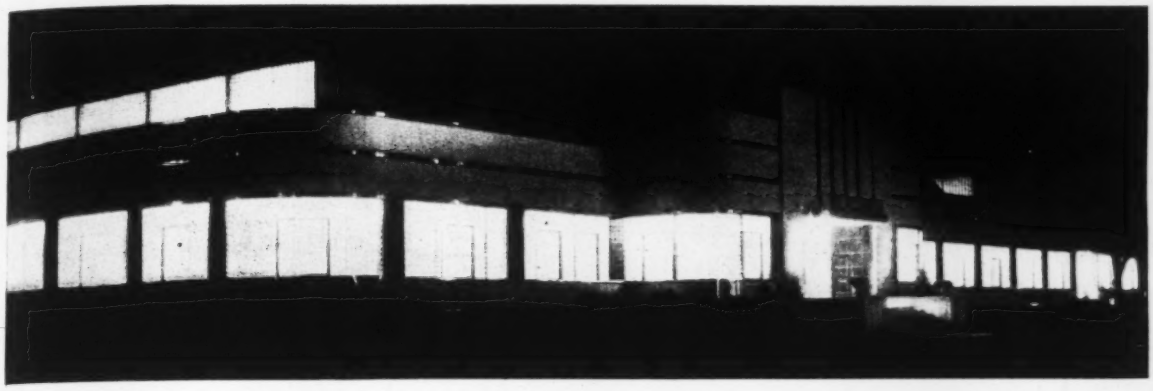


FIG. I. A BUILDING THAT RESEARCH BUILT PRESENTS A COLORFUL STEEL AND GLASS FACADE

Masonry Gives Way to Steel

Porcelain enameled sheets, stainless strip and glass block distinguish new research laboratory of American Rolling Mill Co., in which walls and roof as well as frame are of steel

A COMPLETE BREAK with the past insofar as materials and external appearance are concerned is recorded by the new research building of the American Rolling Mill Co. at Middletown, Ohio, opened last month. Steel walls with outside surfaces of porcelain enamel sheet and stainless strip, steel roof, welded steel frame, sawtooth roofs fitted with glass blocks, fixed plate glass windows framed in glass block, and a wall contour of curves and angles present a contrast with conventional practice that is accentuated by a striking color combination of black, cream and silver. Befitting a research laboratory, a total of eleven of the company's products can be found in the building. Seldom if ever has a structure been built which exemplifies so well the owner's own progress in product development. Except for the structural steel, the concrete and the glass, the entire building is composed of flat rolled Armco products.

Of single-story type the building covers a six-sided plot which may be considered as a large rectangle adjoined on the south by a trapezoid. The rectangle, 255 ft. north and south by 175 ft. east and west, is covered with a seven-bay sawtooth roof except for the outside bay on the west and north which has a flat roof. The entire roof over the trapezoidal area is flat. In general, the area under the sawtooth roofs is occupied by laboratories while the flat roofs are over offices. The 41,900 sq.ft. of space is divided into more than 100 rooms.

In external appearance the building is unique, presenting bands of porcelain enamel, stainless steel and glass that extend unbroken, except for the entrance tower on the west, for nearly 600 ft. around three sides. The watertable base, 1-ft. high, is of black Macotta enameled iron. Above this is a 2½-ft. strip of cream-colored porcelain enamel surmounted by a stainless steel sill 4 in. wide. A similar strip of stainless forms the head lintel above the window areas, and stainless steel also frames the non-opening plate glass windows inset in the glass block panels which, with the black porcelain enamel pilasters, form a continuous band around the building. Above the windows the cream-colored porcelain enamel sheet is repeated in a wall and parapet strip 8 ft. high divided in the middle by a 4 in. stainless strip and surmounted by a stainless cornice of the same width.

The only variation in this facade treatment occurs on the west side. Here a massive square entrance tower extending forward from the line of the main building dominates the appearance with its curved corners and vertical V-shaped bands of stainless steel extending upward to the cornice from a semi-circular marquise of stainless steel at the portal. The only second floor space in the building occurs in this tower, about 1600 sq.ft., which will be devoted to X-ray testing and similar research.

A welded frame

Behind the striking exterior of this building are design and construction innovations of note. They involve frame, walls and roof, and extend to such interior facilities as partitions, air conditioning and trim.

The steel frame of rolled sections is completely welded. The principal feature occurs in the sawtooth roof section where welded bent beams replace the more conventional trusses resulting in a modified rigid frame construction. Free of bracing it permits un-

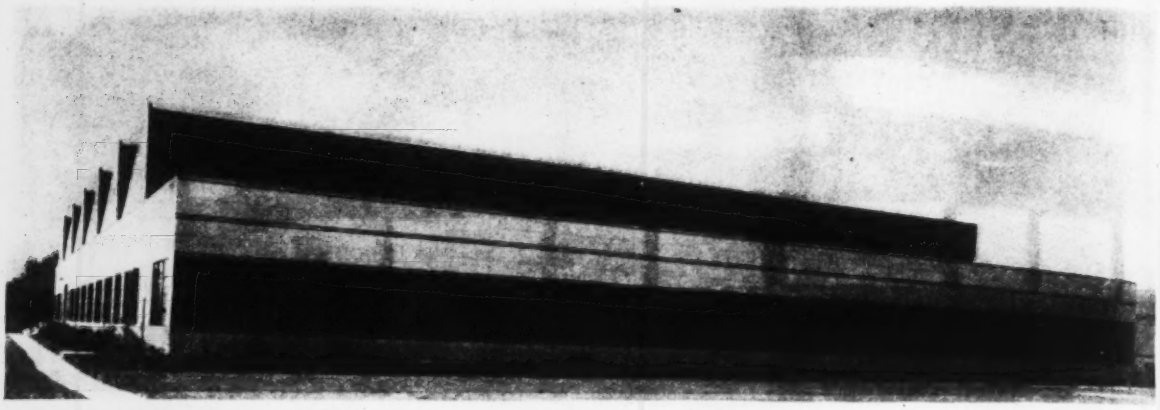


Fig. 2. Sawtooth roof faces on the north side of the new Armco research building introduce glass block inclosures to this type of service. At the left is the temporary east wall in which mica insulation is used between two steel sheets.

obstructed headroom and provides uninterrupted light from the glass block sawtooth inclosures; the bents are spaced 30 ft. apart.

Foundations consist of simple concrete footings, and at the building line a concrete curb is used to support the exterior walls. The floor is a 5-in. concrete slab. All electric, telephone and other service lines are in fiber ducts encased in the floor slab. These are accessible through hand holes every 200 ft.

Thin steel walls

Although steel walls have been used in such small structures as filling stations, the Armco building represents their first use on a large scale. The fact that the Armco walls must function in air conditioning service and are less than 6 in. thick, including exterior and interior trim, make them both unique and significant.

The basic structural body of the walls is made up of flanged galvanized steel pans set on end and interlocked at the edges. Known as Steelox construction, these pans are assembled in units about 7 ft. long and of the height desired and are fastened by bolts to frames of welded pressed steel tubular members 4 in. square. These tubular frames are anchored to the structural frame by welding (Fig. 3).

To this basic wall, insulation and trim are added to complete the construction. On the inside (Fig. 5), rock wool bats 3½ in. thick are installed between the flanges of the Steelox sections to which clip angles and hooks are welded to furnish a fastening for ¼-in. sheets of plywood. The plywood serves both to hold the insulation in place and to form a backing for the interior steel sheet trim. This trim is of 22-gage flat sheet and strip painted, except in such rooms as the library, director's office and lobby where 18-gage furniture steel and stainless strip is used. The

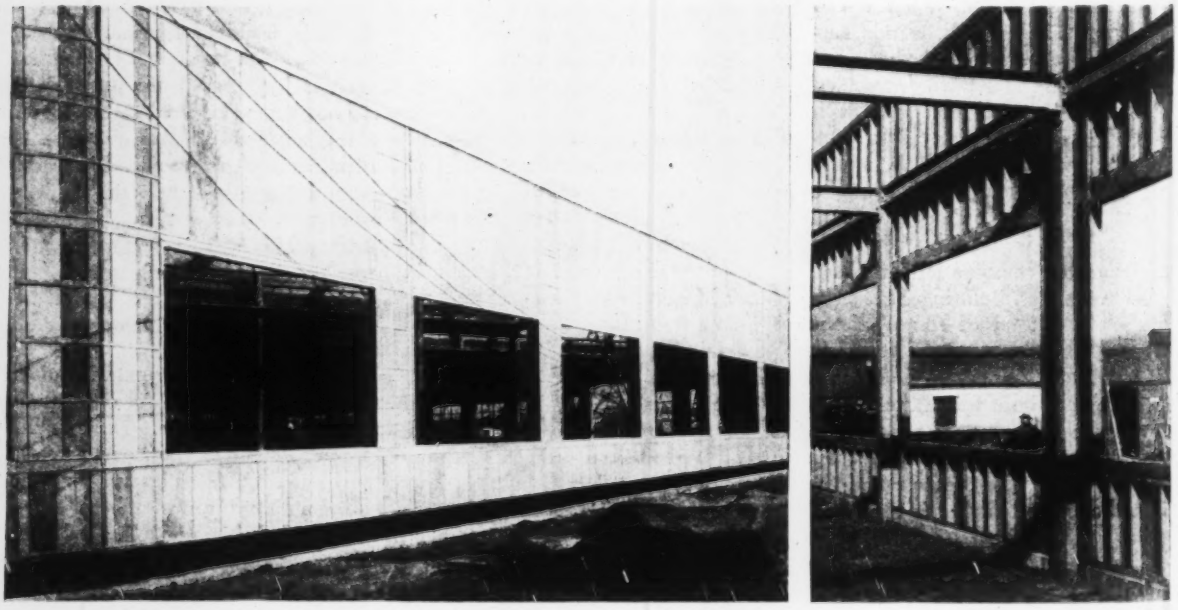


Fig. 3. Thin walls of steel distinguish the Armco research building. Shown here are the galvanized steel pans with interlocking edges set in tubular frames that constitute the basic elements of the wall. On the outside (left) the horizontal clip strips engage the porcelain enamel panels. On the inside (right) rock wool bats are intsalled in the pans and held in place by plywood faced with painted steel sheets.

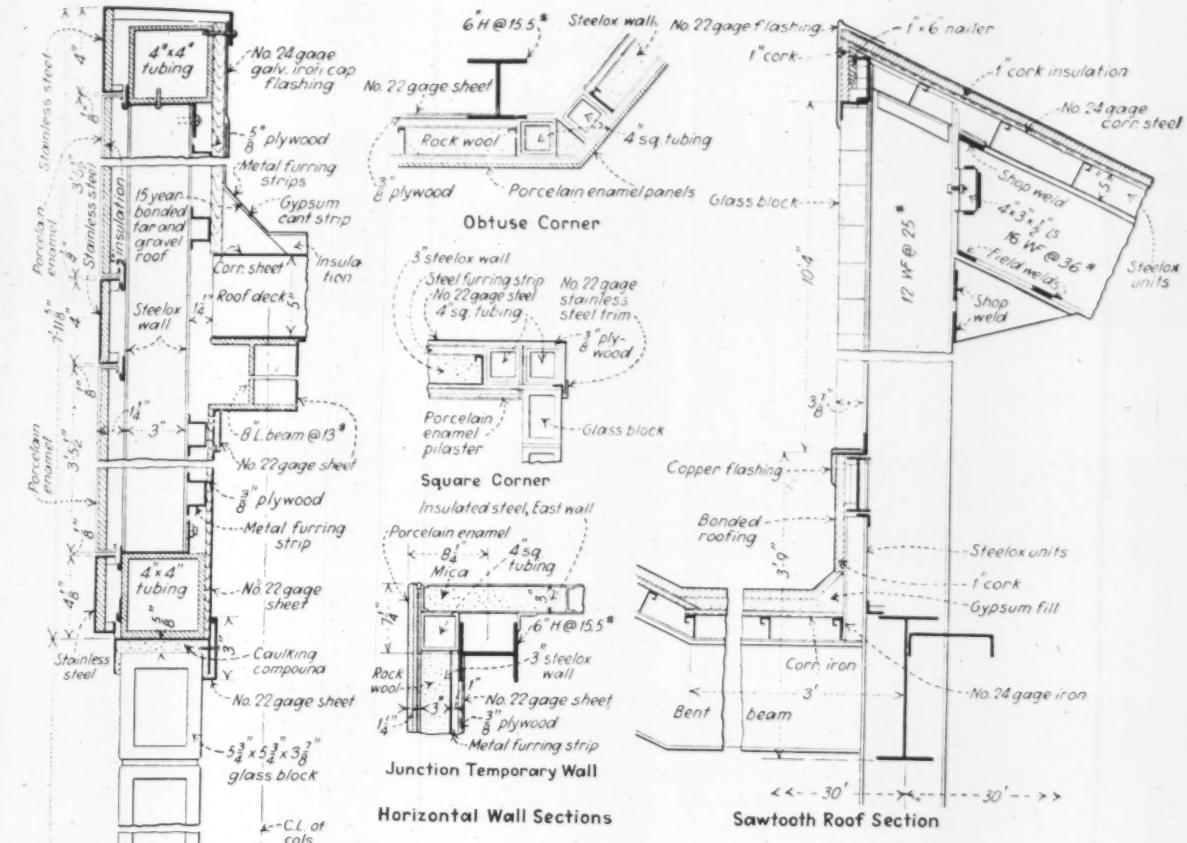


Fig. 4. Structural details of steel walls and roof of Armco research building.

furniture steel is given a walnut grained finish to match column and beam enclosure plates that are used in these rooms.

The outside of the walls is covered with porcelain enamel steel sheet in rectangular flanged panels 16 in. wide and from 16 to 24 in. in height. These panels contain $\frac{1}{2}$ in. of Celotex insulation on their inside and are clipped to strips welded to the Steelox panels (Fig. 6). The stainless steel trim bands, 4 in. wide, are clipped on in similar fashion. All joints are calked with oakum.

A different type of construction is used for the temporary east wall, which is considered as temporary since any future addition will be placed on this side. For this east wall two 20-gage sheets, held 3 in. apart by steel channel stiffeners, form a box section which is filled with Zonolite exploded mica insulation. This simple design is also used for some of the interior partitions and to inclose the ends of the saw-teeth and as flooring in the second story tower room where it is used in a 5 in. thickness on spans of 18 ft. A perforated metal acoustic ceiling backed with gypsum is used beneath this floor which is over offices and the entrance lobby.

The glass block used in the wall panels is $5\frac{3}{4}$ in. square by $3\frac{7}{8}$ in. thick. Installing it and the plate glass windows involved no features of note.

Insulated metal roof

The roof construction on the Armco building is also a departure from usual practice. As in the walls, the basic structural element is made up of the Steelox units. Laid with flanges up, they form pans which, when covered, provide a hollow metal deck (Figs. 4 and 7). These roof units are 5 in. deep and 9 in. wide and their face which forms the ceiling of the rooms below is perforated. About an inch above these perforations a $\frac{1}{2}$-in. layer of acoustical cork is supported on metal chairs to give an effective sound-deadening construction. The tops of the pans are covered with 26-gage galvanized corrugated steel sheet on top of

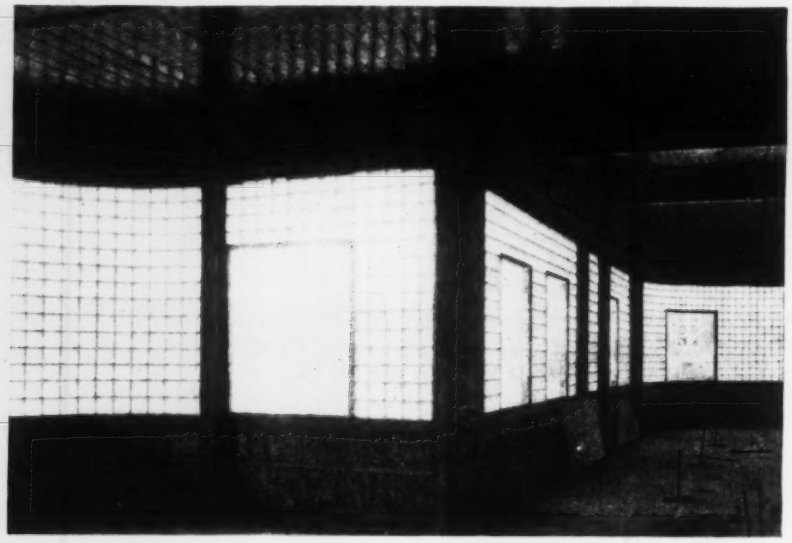


Fig. 5. Ready for interior trim. Rock wool shown held in place by metal furring strips will be covered with plywood and steel sheets. Beams and columns will also be hidden by steel sheet enclosures.

Fig. 6. Clipping porcelain steel panels to steel walls. Joints are calked with oakum.

Fig. 7. Installing acoustical cork in channels of roof decking. Note perforations in deck at right where cork has not yet been installed.

which is a 1-in. layer of cork covered with 4-ply 15-year asphalt composition waterproofing. Since the pans are fastened to the roof framing by tack welds made from above, they are as effective on the sloping sawtooths as on the flat roofs.

The glass block enclosure of the north faces of the sawteeth are really a part of the roof. The glass block panels are 10 ft. high and were adopted to take advantage of north light and to provide effective insulation for the air-conditioned interior. The block used in the monitors are 8x4¾ in. in face dimensions and 3⅜ in. thick. Occurring in continuous runs of 150 ft., they are divided into panels 15 ft. or 21½ blocks long by expansion joints consisting of a galvanized tee section set in oakum.

Metal partitions

Inside, the building is divided into more than 100 individual offices and laboratory chambers. Large rooms are the physical testing laboratory and central receiving and storage aisle, 30 ft. wide, which opens to the rear of the building and is equipped with a 4-ton hand-operated trainrail hoist to facilitate handling of testing materials. Ceiling heights in the offices are 12 ft., while in the laboratory the minimum is 14 ft. and the maximum, at the top of the sawteeth, is about 28 ft.

Many feet of partitions were required, and the most modern types of metal design were adopted. Developed by Hauserman, these partitions are 3 in. thick and are packed solid with an inorganic filler that renders them soundproof although they do not extend to the ceiling. Where complete enclosure is required, a single sheet of metal is used between the top of the partition and the roof. The inorganic filler is also claimed to make the partitions highly fire resistant.

Refinements in the partitions are stainless steel trim at all horizontal joints, concealed wiring facilities in the base, provisions for piping within the partition and felted door strikes at all openings. The partitions are movable, not being fastened to the 5 in. concrete slab floor but merely held in place by small bracing angles.

Air conditioning

Entire dependence for heat and ventilation is placed on the air conditioning system. This is divided into two parts, one for the offices and one for the laboratory. The office section is conditioned by two units providing zone control for the space with northern and western exposures, respectively. Three units serve the laboratory, each providing zone control over a practically closed system of its own.

Each conditioning unit consists of a mixing chamber, air filter, humidifier, cooling unit, heat coils and a

blower. Cooling is effected by deep well water, while heating is by low pressure steam. Each unit has its air intake through the glass block in one of the sawtooth faces. All five units are located in the peaks of the sawtooth roof.

There are several heat and fume exhaust systems in the building which afford the only means of ventilating the laboratory and shop rooms. The air conditioning units are controlled by these exhaust systems, assuring the proper amount of outside air.

Conditioned air is furnished the rooms through diffusing grilles near the ceiling. Air is recirculated from the rooms through other grilles some of which are near the ceiling to take out warm air in summertime and others are near the floor to take out cool air in the winter.

The offices in the summer are cooled to 80 deg. F., with 50 per cent relative humidity, when the outside temperature is 95 deg. F. In the winter, heating is to 70 deg. F. when the outside temperature is zero. The relative humidity in the winter is considerably above that for the average office building due to the highly insulated nature of the walls and roofs. The laboratory section is conditioned similarly to the offices.

The new Armco research laboratory will cost about $260,000 exclusive of the testing equipment. It was designed and built by The Austin Co. of Cleveland in cooperation with Harold Goetz, architect, Middletown, Ohio. The eleven Armco products used in its construction are the Macotta iron base; the porcelain enamel wall panels; the perforated Steelox roof decks; the solid Steelox wall units; corrugated galvanized roof sheets; the stainless steel trim; the insulated steel temporary wall units; three types of partitions—Steelox, insulated steel and Hauserman; the air conditioning ducts; and the inside wall sheets.

More Space, More Light, More Efficiency

United Aircraft addition for Hamilton Standard Propeller Division shows substantial advance in design over original factory, which was ultra-modern in 1930

SEVEN years ago the United Aircraft Corp. opened a new factory in East Hartford, Conn., to serve two of its manufacturing divisions, Pratt & Whitney Aircraft, builder of engines, and Hamilton Standard Propellers, manufacturer of controllable-pitch propellers. Two years ago the operations of these two divisions had grown to such an extent that the 400x1,000 ft. building was no longer large enough. Expansion was necessary. The result was the construction of a 256x425-ft. addition adjoining the existing factory on the south, into which propeller manufacture has been transferred. Side by side, therefore, are two factories whose planning stages were separated by a period of only seven years. Yet the changes to be noted are substantial and support the claim often made that the industrial building reflects developments in materials, equipment and design more quickly than any other engineering structure.

Both the original building, now the Pratt & Whitney factory, and the new addition, the home of Hamilton Standard Propellers, have the same general external appearance and are of the same general type, consisting of a two-story headhouse of tier construction, with the factory bays, of single-story monitor-roof type, running at right angles to the headhouse. It is in details that the new addition reflects new design trends. For example:

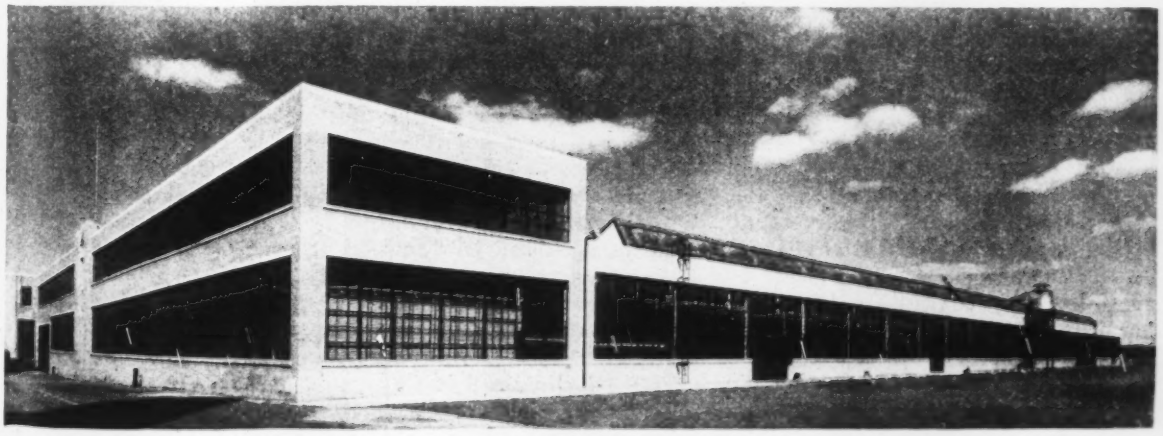


Fig. 1. Life begins for a majority of the world's airplane propellers in this modern industrial plant.

Fig. 2. What the modern factory will wear. A typical 64-ft. bay accommodating four lines of machines served by continuous overhead power ducts and floodlighted by day through large areas of glass sash and by night from high-intensity mercury-vapor lamps. Large-capacity overhead unit heaters provide winter comfort.

The original factory has 32x40-ft. bays; in the new adition they are increased to 64x64 ft.

The monitors of the original factory have single, sloping, ventilating sash windows; double, sloping windows are used in the new design. Also, the older monitors abutted against the second story of the headhouse, while the new monitors are stopped off about 20 ft. short and windows are installed in the end faces. This change greatly improves natural light conditions and ventilating in the second story of the new headhouse. It also suggested cutting back the original monitors, an alteration which was made recently.

In the new addition, natural light in the interior is substantially superior to that in the original building by virtue of an increase of the ratio of monitor width to clear spacing between monitors from 2½:1 to 3 to 1.

In the original factory artificial light is supplied by overhead incandescent lamps supplemented by individual lights for the machines. High-intensity, mercury-vapor, overhead units, 16 ft. apart each way, light the new addition.

Electric power wiring in the original factory is carried in a multiplicity of conduits with fixed outlets. A single bus duct over each two lines of machines, into which power cables may be plugged at 12 in. intervals, is used in the new addition.

In the original factory heat is supplied by a hot water system with radiators along the walls. In the new addition unit heaters of the rotating type incorporating a two-way discharge of the hot air are used.

Truck loading docks for the original factory are outside while the new addition has an enclosed dock entered through overhead doors operated by electric motors.

In the original factory the locker room is located in the basement; in the new addition half of the second floor of the head house, with greatly improved light and air conditions, is devoted to this service.

Wood block floors are used in both the old and new construction but smaller blocks are used in the new addition; they are said to produce a firmer floor because of the greater length of asphalt joint relative to block area.

Such comparisons amply justify the claim of more space, more light and more efficiency for the new addition. They are also useful in placing the brief description that follows in its true perspective.

In planning the new building two basic requirements were recognized. First, although merely an addition to an existing plant, the new building was to be a complete and autonomous factory with its own offices, receiving and shipping facilities and manufacturing area. Second, since precision machining and delicate handwork constitute the bulk of production operations, exceptional light, both day and night, was required.

The building chosen to meet these requirements has plan dimensions of 256x450 ft., the long dimension being east and west. A two-story headhouse section, 38 ft. wide and 256 ft. long at the west end, houses plant offices in one end of the second floor and workmens' locker, shower, toilet and lunch rooms in the other. Placing locker rooms in such a favorable location is somewhat unusual but such an arrangement was adopted in the belief that adequate light and ventilation are essential if satisfactory locker room conditions are to be maintained. The first story is a part of the factory floor; at one end is an interior receiving dock with an 33x41-ft. truck space, entered through overhead doors operated by a 3-hp. motor, while on the remainder of the first floor area manufacturing parts are stored, ready to start down the production lines in the factory.

The 256-ft. width of the single-story factory is divided into four 64-ft. bays, over each of which is a monitor 340 ft. long. Production lines are arranged under each of these monitors, with the machines under the sash areas and a trucking aisle on the centerline. Headroom is 14 ft. The 64-ft. bay dimension in the longitudinal direction resulted from the desirability of matching column lines in the adjacent original building which were spaced 32 ft. Then, by choosing a similar 64 ft. dimension in the transverse direction, the bays were made square, which was advantageous on the floor plan and in addition permitted the use of wider monitors, which improved the lighting conditions. As compared with the original factory with 1,280 sq.ft. of floor and roof per column, the new addition provides 4,296 sq.ft.

In the headhouse, the second floor is framed with beams spanning 38 ft. from wall to wall and supporting a 4 in. concrete slab. In the office portion linoleum floor covering is used and the walls from floor to window sill are faced with buff, glazed tile. This same tile is used in the locker and shower rooms. Hung acoustical ceilings are used and are supplemented by 7 ft. high sound-deadening metal partitions, $2\frac{3}{4}$ in. thick, filled with mineral wool. Although the partitions do not extend to the ceiling, a remarkable degree of quietness is obtained.

The factory floor is a concrete slab surfaced with creosoted wood block of 2x2x8 in. size. There is no basement but manufacturing requirements dictated the use of two trenches 4 ft. deep and 4 ft. wide under the floor in one bay. These trenches accommodate suction pipes serving grinding benches arranged along either side of them. Metal filings from the popeller blades are sucked immediately into these trenches, through which they are conveyed to an overhead bin for periodic removal. To replace the air sucked out by this operation, an air intake and a blower are installed in the roof above this department.

Among the facilities provided to achieve ideal working conditions, the heating and lighting are notable. Units for both are suspended at about the level of the lower chords of the roof trusses. The steam heaters, of which a total of 35 are required, are large enough to serve one bay, or about 4,200 sq.ft., with warm air discharged through two ports as the units rotate. The heaters are hung directly beneath the monitor centerlines and over the trucking aisles.

In order to eliminate any necessity for individual artificial lights at the machines, recourse is had to high-intensity mercury-vapor lamps. Each of the 403 units is of 16,000-lumen size and, placed four per bay of 4200 sq.ft., they provide 40 ft.-candles of light on the working plane. Shadows are largely absent, and the blue light is claimed to be restful for the eyes.

The small-parts storage room and a toilet room are both designed to conserve usable factory floor space. The toilet room is, in fact, hung between two of the monitor trusses above the floor and is reached by a stairway. The small-parts storage room, although it occupies factory floor space (22x24 ft.) is two stories high. Built entirely of interlocking steel units, the bins and shelves form the structural framework of the room, which is enclosed in heavy wire.

Bays 64 ft. square

From a structural standpoint, the outstanding feature of the new build-

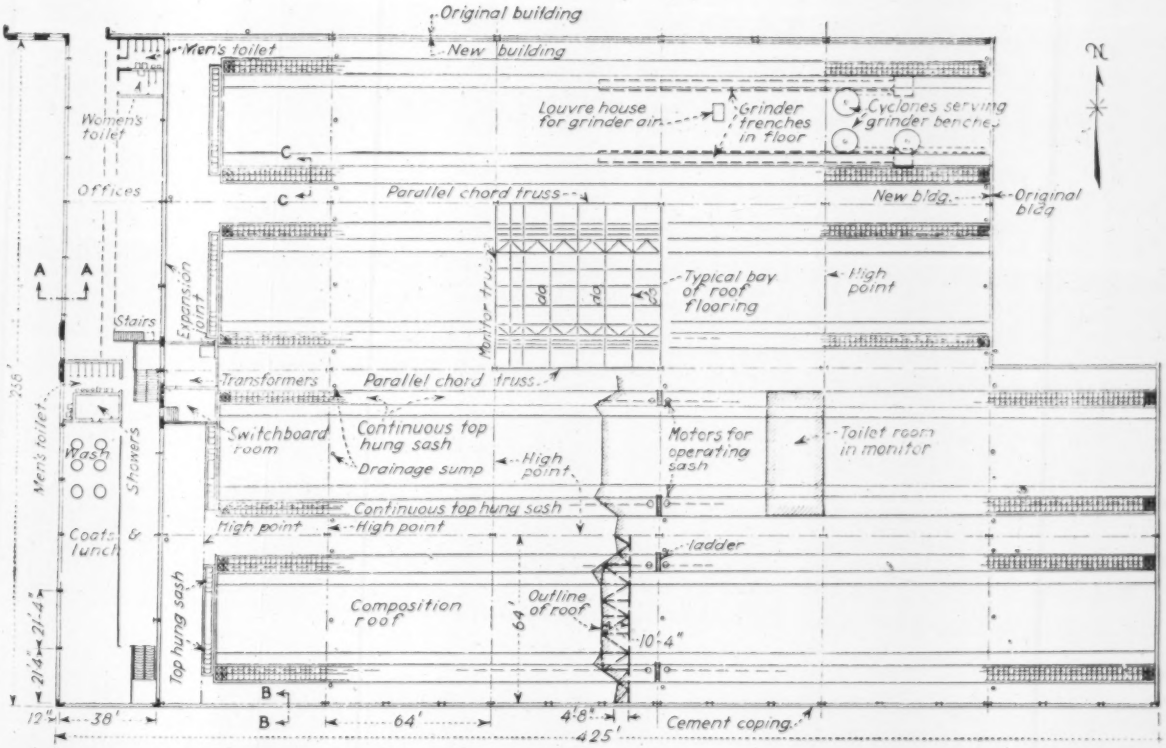


Fig. 3. Plan of roof of Hamilton Standard Propeller plant at East Hartford, Conn.

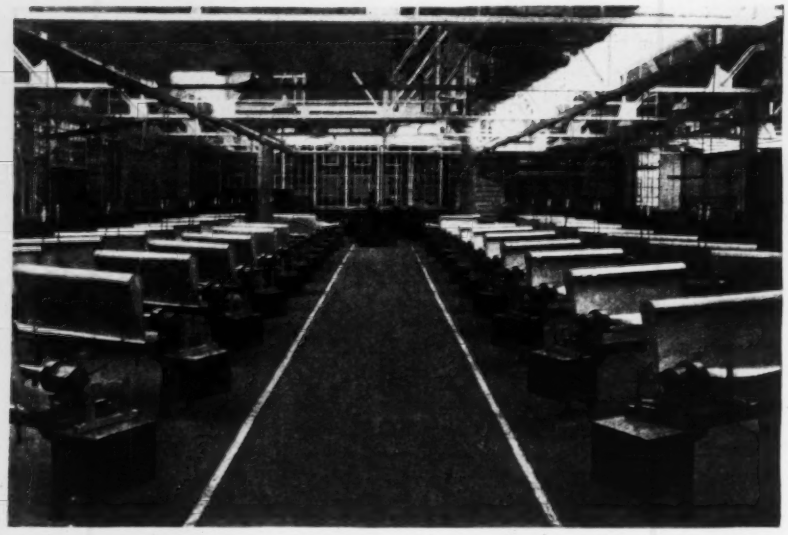


Fig. 4. In the propeller grinding department continuous suction on each grinding bench removes metal particles to ducts in underfloor trenches.

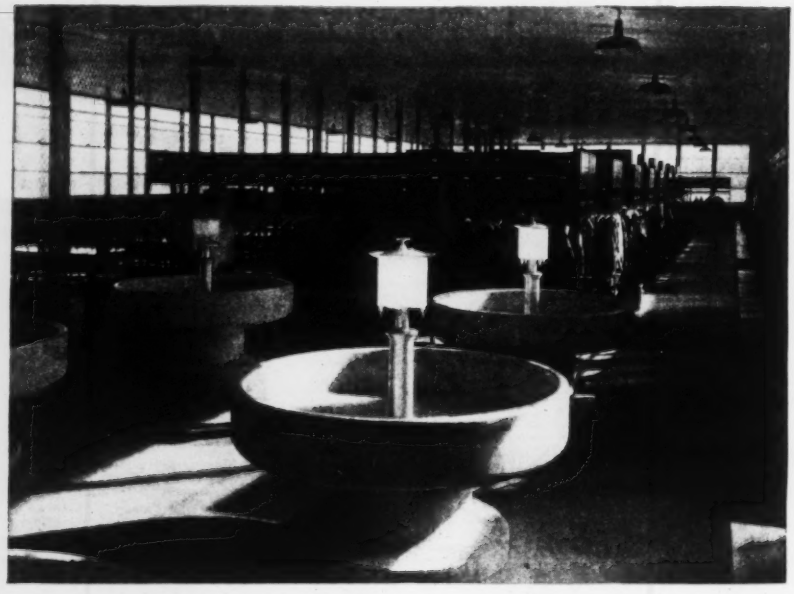


Fig. 5. Locker and wash basin facilities are housed on the second floor of the headhouse to assure adequate natural light and air. Behind the screen partition are lunch tables.

ing is its use of 64 ft. square bays, providing over 4000 sq.ft. of floor space per column. Such wide spacing, so beneficial to flexibility of machine placement, to materials movement and to natural lighting efficiency, is achieved with no greater roof truss depth than was required for the 40-ft. spans of the original building. The expedient responsible for this result was the choice of cantilever trusses. With such design the trusses are continuous over the columns, and every second bay contains a suspended span.

A typical 64-ft. square bay is framed with two parallel-chord trusses in the longitudinal direction, one on each column line, and four monitor trusses in the transverse direction; two of the monitor trusses are on the column lines and two are carried by the parallel-chord trusses. While trusses vary somewhat in makeup due to local load conditions, a typical longitudinal truss has two angles 8x6x$\frac{7}{8}$ in. for a top chord and two angles 5x5x$\frac{7}{8}$ in. for a bottom chord, the latter reinforced over the center half of the span by a 9x$\frac{5}{8}$ in. welded cover plate. Each of the members in the Warren web consists of a pair of angles. The trusses are 4 ft. 9$\frac{1}{2}$ in. deep and carry a maximum chord stress of 342,000 lb.

For the monitor trusses, a depth of 4 ft. 8 in. at the columns is increased to 10 ft. 4 in. at the center of the span. Top chord angles are 5x5x5/16 in. and bottom chord angles 4x3$\frac{1}{2}$x5/16 in. The chord stress is about 55,000 lb.

Roof design

From a natural lighting standpoint, the roof design chosen has proved unusually successful. Supplemented as it is by the mercury-vapor lighting for cloudy days and for night work it meets the difficult requirements laid down for it at the beginning of the design work. The principal reason for this success is believed by the designers to lie in the proportions of the monitors which in turn are largely a result of the wide bays. Thus, in the 64-ft. span between columns, the monitor occupies 48 ft. or 75 per cent. Stated in another way, the ratio of high roof (monitor) to low roof is 3 to 1.

A plan of this roof layout is shown in Fig. 3. The monitors are of the sloping-window type and have one line of movable and one line of fixed sash. The movable sash in each monitor face is divided into two lengths at the transverse centerline of the building, each length (the maximum being about 175 ft.) being operated by a 2-hp. motor. At the west end the monitors are stopped off 20 ft. short of the headhouse. This arrangement removes any possible obstruction to light entering the second floor offices, and by installing sloping windows in the monitor ends additional light is admitted to the factory.

A metal roof deck covered with 1 in. of insulation board and tar and gravel roofing is used on both the headhouse and the factory. Drainage on the factory roof is taken care of by three lines of sumps as shown on Fig. 3.

Both the original Pratt & Whitney factory and the Hamilton propeller plant were planned and designed by Albert Kahn, Inc., of Detroit. Raycroft Walsh is general manager of Hamilton Standard Propellers.

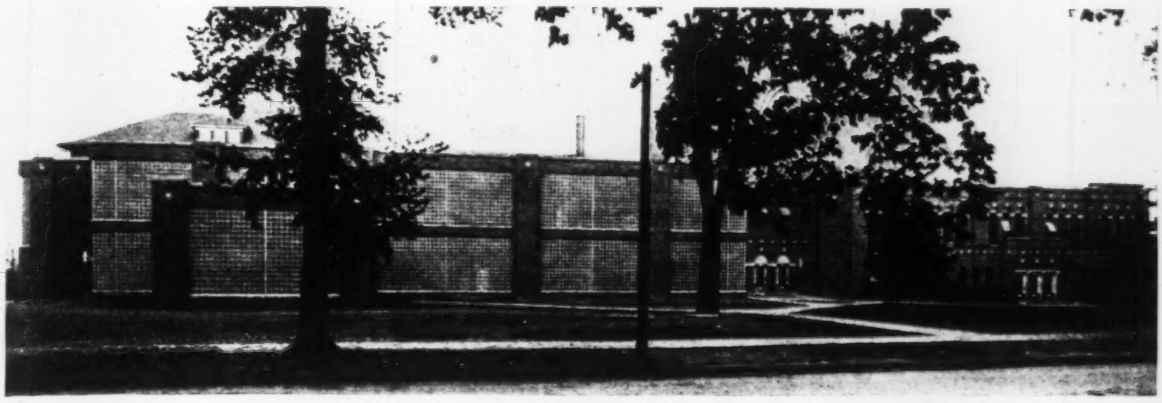


FIG. 1. THE NEW AND THE OLD IN SCHOOL BUILDINGS AT ELKADER, IA.

School Without Windows

Glass block walls in a concrete frame with cantilevered floor slabs give Elkader, Ia., a unique school building

THE FIRST SCHOOL building to forsake windows entirely for glass block walls was completed this Fall in Elkader, Ia. Quite definite educational objectives as well as architectural motives led to the adoption of the design, which is further characterized by a two-story reinforced concrete frame in which the floors cantilever beyond the columns at the exterior walls. The new structure replaces one destroyed by fire, and adjoins a gymnasium built in 1926. The entire school organization, excepting the primary grades and the junior college, is housed in the new building.

Objections to present designs

The Elkader school building is significant principally because of the architectural and design thinking that produced it. Oren Thomas of Des Moines, the architect, had long entertained definite objections to contemporary school design methods as respects natural light and ventilation. For example, the usual practice has been to provide window or glass area on the exterior walls of class-rooms equal to about 30 per cent of the floor area. With wall-bearing design, such as is used in most schools, this is about the maximum area that can be punctured with holes, yet it does not provide sufficient light during a good percentage of the hours of the school year. On the other hand, if a skeleton frame is used, permitting more glass area, glare and excess solar reflection result, while at the same time infiltration of air through the window construction and conduction of heat and cold through the solid glass are disturbing and expensive in most climates.

Another objection relates to the operation of windows and the resulting effect on the heating and ventilating system and on the health of the school children. Different instructors have entirely different ideas as to proper temperature and ventilation. Some invariably open too many windows creating undesirable drafts and throwing the mechanical ventilation system out of balance. Others insist on unhealthful 80 deg. temperatures in winter.

A third objection to orthodox school buildings is that corridors invariably have inadequate natural light, unless the building plan is of an extremely open type and therefore costly to construct. It is not so much a problem of providing sufficient light for traffic as it is of supplying enough light that the student can read books and notes that are taken from lockers located in the corridors. While obscure window glass partitions might admit the light they would also permit corridor noises to be transmitted into classrooms.

Finally there is the objection to dust and noise from the outside, which increase cleaning expenses and distract pupils and teachers. Out of all these objections, Mr. Thomas evolved a four-point specification. Thus, a modern school building should permit:

1. A practical increase in the intensity of natural light within the rooms and the corridors.

2. A means of obtaining (1) without excess exposure or infiltration of cold air and conduction of heat and cold.

3. A mechanical ventilating system that is adequate yet more economical, and with no option on the part of the school authorities as to whether or not it would be used.

4. Elimination of dust and dirt

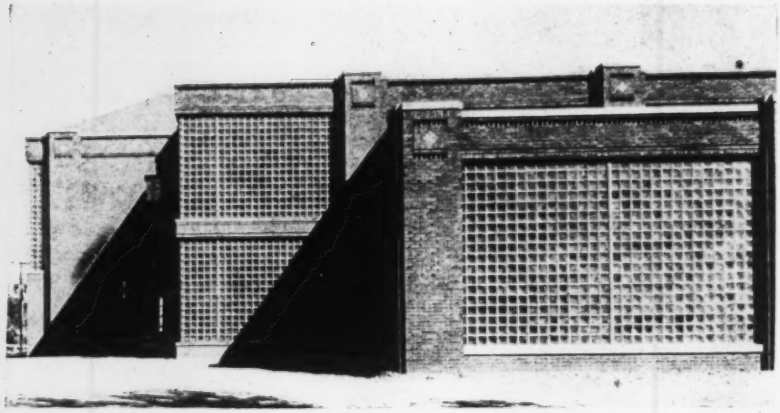


Fig. 2. A unique exterior appearance results from combining glass brick and clay brick, the latter repeating a design on the adjacent gymnasium.

infiltration and distracting noises from the exterior.

Use of glass block

The advent of hollow glass block construction seemed to offer an opportunity to meet the above specification, and the new Elkader school building is the first attempt at a full-size experiment. To date it is the belief of the school authorities, the teachers, pupils, parents and the architect that the experiment is a success. The objections to conventional building design have been overcome, and there is said to be adequate light without glare in all classrooms and corridors for at least 95 per cent of the school day.

As to the school building itself the glass block extends from floors to ceilings and along at least one side of every classroom. It is not used in the side walls of the library stack room, the entrance lobbies or the auditorium. On the south and west exposures a block admitting about 75 per cent of the light is used, while on north and east the structure of the block is changed to permit 85 per cent of the light to be transmitted. Some of the corridor walls are entirely of glass block while in others panels of glass block are used with cinder block, the latter condition obtaining where lockers or laboratory equipment are placed against the walls.

The building is heated and air-conditioned from a basement plant, with distribution ducts placed in furred ceilings. Automatic temperature regulation assures about 70 deg. in each room. Moisture is added to the air to provide the proper humidity.

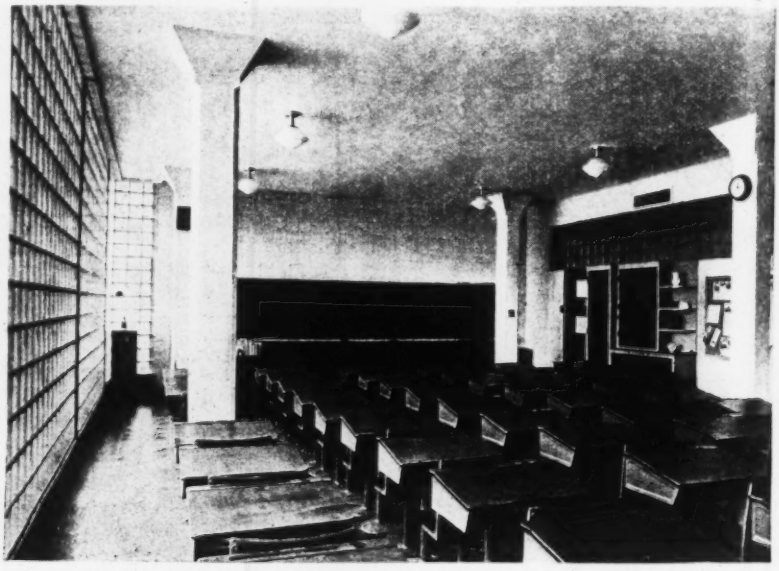


Fig. 3. Typical windowless school room providing adequate light through glass block walls and ventilation through an automatic system divorced from the whims of the teacher. Location of columns in room is notable.

The structural frame designed for the building is unusual for schools, and was adopted to secure full value of the glass wall area. Thus, the second floor is cantilevered about 3 ft. beyond the columns (and as much as 8 ft. in some cases), and the walls are set on these cantilevers. The interior columns are also located in the classrooms, about 3 ft. inside the corridors, leaving the whole corridor wall available for glass block. In a typical classroom, therefore, the columns are located at the edges of the usual aisles at the sides of the room and do not interfere either with seating arrangements or vision.

The building is L-shaped, and in the leg whose elevation is shown in Fig. 1, a cross section reveals a four column bent with three spans of about 18 ft. plus the cantilever overhangs. In the other leg of the L, adjacent to the gymnasium, there is a 40-ft. wide auditorium spanned by trusses and a three column bay accommodating a line of classrooms and a corridor. The floor is a precast-block poured-joist slab reinforced two ways. The use of brick pilasters, spandrels and parapets resulted from an attempt to provide an element of continuity with the existing and adjoining gymnasium building.

The Elkader school was designed and its construction supervised by Oren Thomas, architect, Des Moines, Iowa. A PWA project, its total cost was $148,000. The general contractor was the Kucharo Construction Co., Des Moines, Ia.

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Color in Walls Obtained by Combining New Materials

Distinctive appearance is given the walls of the new windowless plant of the Cudahy Packing Co. in Albany, Ga., by a combination of three modern materials. Pilasters faced with glazed tile protrude beyond the glass block wall panels producing a series of vertical shadows which contrast with cornice and coping made up of stainless steel.

Parking on the Roof

Customer parking lot for Marshall Field department store in Evanston, Ill. is raised to roof of auto service station thus making "taxpayer" building do double duty

A DESIRE to make parking lots more profitable is giving rise to a new trend in building design in which the structure serves to support an elevated parking area. One of the most notable examples of this type of building was recently completed by Marshall Field & Co. on a parking lot adjacent to the company's department store in Evanston, Ill. By erecting a one-story building, which is leased to the Firestone Tire & Rubber Co. for an auto service station, and designing the roof as a parking area, the company increased its income from the property and assured better parking facilities for the store's customers. The roof is reached by a curved ramp along two sides of the building. Space for 50 cars is provided, and the only change required in the store building was the cutting of an entrance door through the wall at the second floor level.

In addition to its interesting functional characteristics, the building incorporates somewhat unusual framing for a small structure by virtue of requirements for a large open area devoid of columns in the service station and because of a cantilever canopy roof at one side.

About 160x110 ft. in plan, the building is on a corner plot, with streets on two sides and an alley on the third side. The fourth side adjoins the department store. Framing is of steel. Wall areas on the street sides are occupied by plate glass and overhead doors (one of 20 and one of 40 ft. width), extending from a curb to the underside of the roof framing. Glazed and colored terra cotta backed with tile forms the parapet. On the alley and department store sides, walls consists of 12 in. of brick. The ground floor is a 6-in. stone-concrete slab on a 6-in. cinder fill. On the roof a 5-in. Haydite-concrete slab is topped with 2 in. of asphalt. Terrazo floors are used in the locker room and toilets which are finished with metal lath and plaster. A quarry-tile floor serves the greasing racks.

Service station

The layout of the first floor (Fig. 2) is a result of careful planning to permit orderly movement of cars requiring diverse types of service. An entrance on one street and an exit on the other promotes such movement. Another aid is the absence of all columns in the large central service area 55x67 ft. in plan. Battery and ignition, tire repair, wheel and brake testing and greasing stations are arranged around the central area so that cars can be moved into and out of them with a minimum of interference. The display room is located at the front corner adjacent to the store. Gasoline and oil dispensing are kept outside of the building but under the roof.

The gross dimensions of the service station floor are about 85x100 ft., in which area there are only five interior columns. These are protected by concrete wheel guards; downspouts from the roof are also placed within these guards. A 3/16-in. steel plate enclosure extending from floor to roof and filled with concrete surrounds each wall column giving it the mass of a 21-in. diameter column.

The ramp to the roof is entirely within the building, rising on about a 14 per cent grade along the north and east sides. Providing 10 ft. wide entrance and exit roadways separated by a 20-in. wide center curb, it is enclosed in brick walls and a concrete slab roof.

Design of a roof to serve as a parking area follows the same requirements as for a multiple-story garage. Under the new Chicago code the live load to be provided for is 50 lb. per sq.ft. when only passenger cars are to be carried. Such a load was used for the Field parking floor, but in addition provision was made for a concentrated load of 3,000 lb. In other words, the framing was designed for a 50 lb. uniform load while the slab was made adequate to carry a 3,000 lb. load on any 4x4 ft. area. These relatively simple requirements were made somewhat more difficult to meet in this building than in the usual structure by

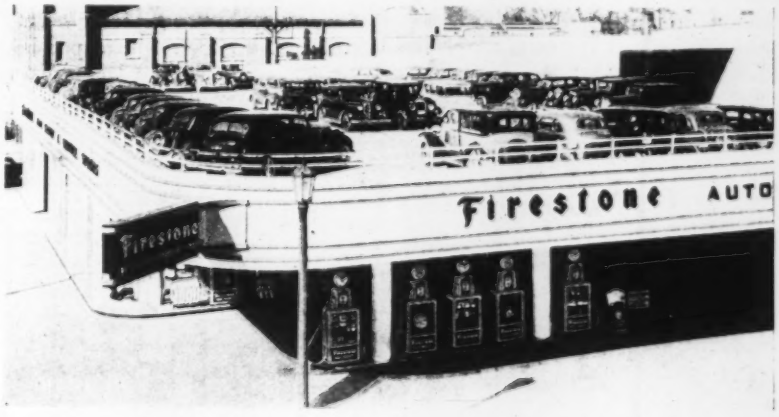


Fig. 1. Accommodating fifty cars, this roof, adjoining Marshall Field store, is over a service station framed with long spans.

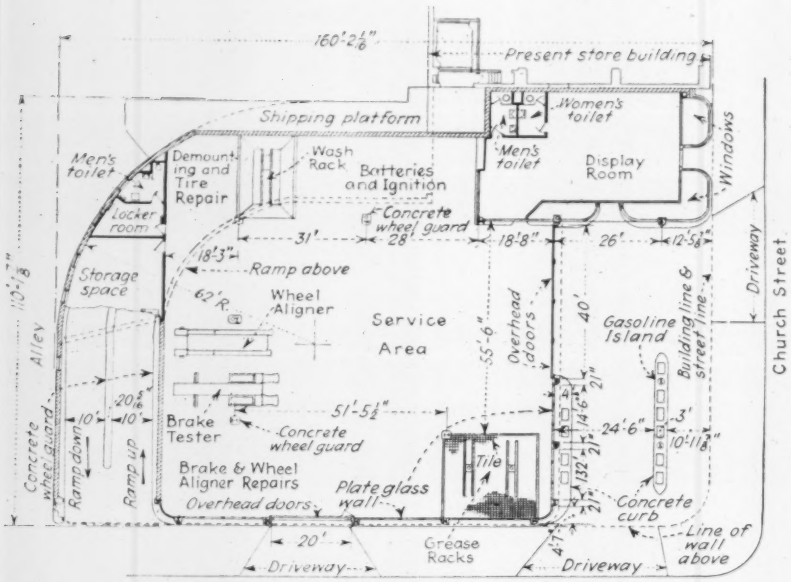


Fig. 2. Service station floor layout, with a minimum of column obstructions is planned for free movement of vehicles in and out of various work areas.

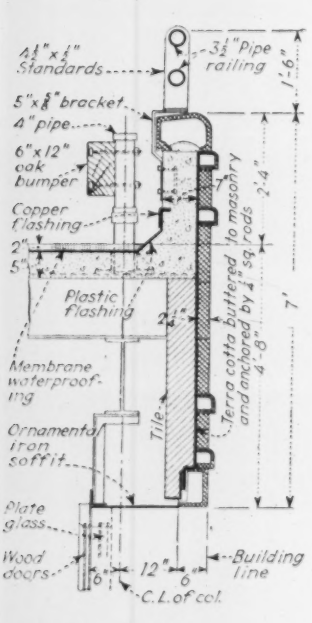
virtue of the use of long beam spans.

The roof framing members and columns (Fig. 3) are of rolled sections throughout, the columns being of 8-in. and 12-in. size, with the heaviest a 12-in. 40-lb. section. The principal roof areas of interest are those over the columnless service area and over the gasoline pump concourse on the south or Church St. side. Over the service area the main carrying members are girder beams of 30 to 36 in. depth which span between the columns. The largest is a 36-in. 280-lb. section on a span of 51 ft. 5½ in.

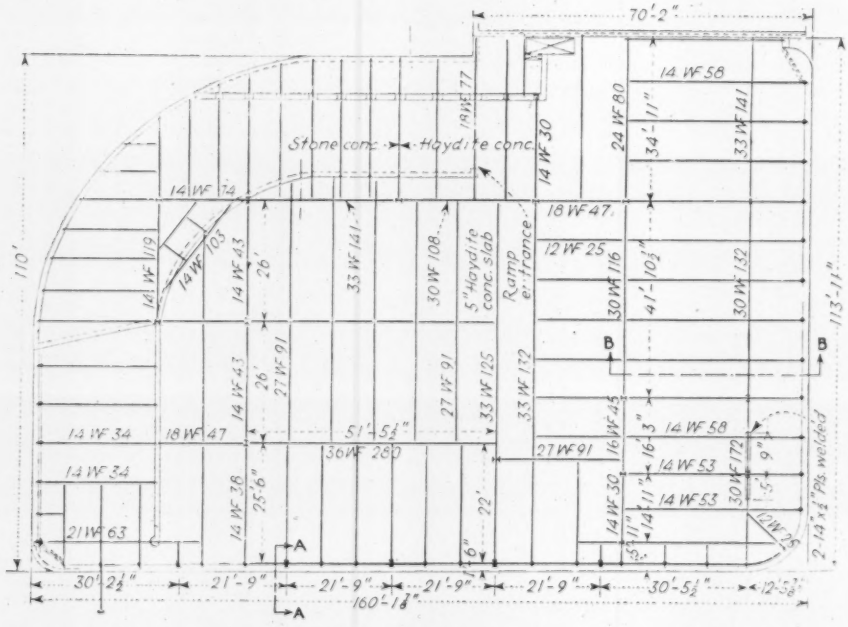
On the south side of the building, over the gasoline pump concourse, the roof cantilevers beyond the last row of columns. This cantilever is 12½ ft. long except at the southwest corner where it increases to about 20 ft. Framing for this condition consists of 30-in. girder beams supporting 14-in. 58-lb. continuous beams having a 26-ft. anchor span and a 12½-ft. cantilever. At the corner, the 30-in. girder beam extends some 20 ft. over the column to carry the framing for the 20x40 ft. cantilever canopy. Over the supporting column, two ½-in. cover plates 14 ft. long are added to the girder beam for reinforcing. Although such cantilevers are not difficult to frame, considering strength alone, it was necessary in this case to exercise great care in securing a layout whose deflection would not crack the plaster of the ceiling below.

Parking on the roof

The parking floor slab is made of Haydite concrete in the interest of light weight. The 5-in. slab is turned up at the edges of the building to form the parapet as shown in Fig. 3. Sturdy bumpers were a necessity to protect this parapet from collision, and a separate bumper fence therefore was installed. Posts are 4 in. diameter pipe on about 7 ft. centers, carrying down through the floor slab to a connection with the roof beams.



Section A-A



Roof Framing Plan

Fig. 3. Details of the parking roof featuring long girder spans and cantilever beams as well as safety rails and bumpers around the parking area.

The posts are reinforced just above the slab by two pipe collars welded together and welded to the posts.

A different bumper detail is used along the brick wall of the ramp enclosure. Here an 8x11-in. reinforced concrete beam, cast flush with the wall, contains anchor bolts for a split beam bracket. Bumpers attached to these brackets and to the posts along the parapet are 6x12-in. oak timbers.

As a final protection a pipe rail is used above the parapet. Because the coping is terra cotta, this rail could not be anchored to it, and curved bar posts were developed which are connected to the inside face of the concrete parapet.

The slab wearing surface consists of 2 in. of asphaltic concrete separated from the slab by a membrane waterproofing.

The building was planned and designed by Graham, Anderson, Probst & White, Chicago architectural firm, of which Magnus Gunderson is chief structural engineer.

Getting Ready for Bigger Airplanes

New assembly building for Glenn L. Martin Co. has clear floor area the size of a large city block to accommodate construction of the super Clipper ships of the future

AIRPLANE manufacturing requirements, which tend toward larger and larger unobstructed floor areas, are forcing the development of a new type of industrial building. Similar to the familiar airplane hangar, its dimensions go beyond the structures so far built for this purpose, and the necessity for weathertight walls, optimum natural light, high intensity artificial illumination, comfort heating, electric power services and overhead cranes place the airplane factory as it has been constructed during the past two years in a class by itself.

The latest and largest building of this type will be completed this month by the Glenn L. Martin Co. Long an exponent of large aircraft and well known for its China Clippers and Martin bombers, the company plainly expresses its philosophy in the new addition to its Baltimore plant by designing a building capable of housing the construction of large single orders of even larger airplanes. Known as the assembly building, the structure has ground dimensions of 308x453 ft. and contains no interior columns. Although a single-story building, it has an overall height of 74 ft. and a clear ceiling height of 40 ft. under the cranes which operate on rails suspended from the lower chords of the roof trusses.

From an engineering standpoint, the assembly building is notable for 303-ft. span parallel-chord roof trusses that make its large unobstructed floor area possible, for an extensive underfloor installation of utility lines and hot air heating ducts and for a new type door that provides an opening 300 ft. wide and 40 ft. high. Also included in the new expansion program is a three-story air-conditioned engineering and research building of reinforced concrete adjoining the existing office building. Representing an expenditure of over $2,000,000, the new construction adds 256,000 sq.ft. of floor space to the plant, bringing the total to about 650,000 sq.ft. Begun in May, the new buildings were completed on Dec. 1.

The story behind the choice of such large dimensions for the Glenn L. Martin Co. assembly building is the simple one of planning today for

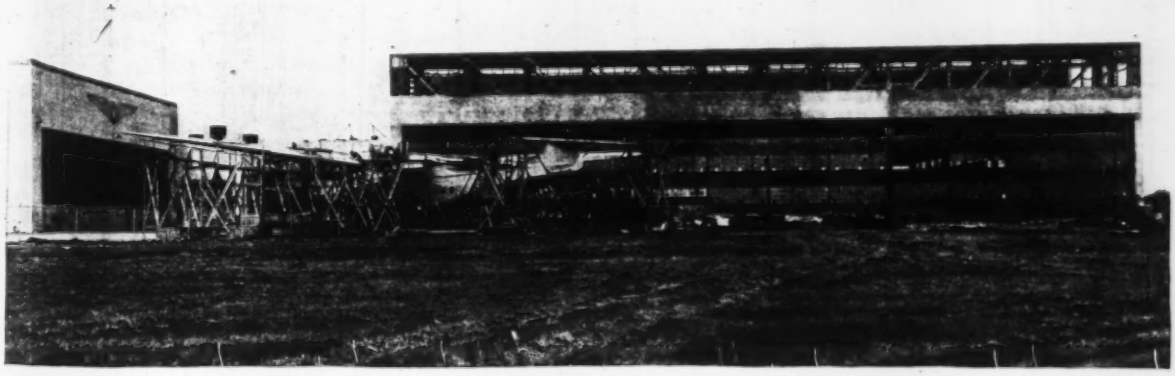


Fig. 1. **Too big to handle in the old building at the left where the China Clippers were built, this 157-ft. span ocean transport is being assembled outdoors. Six like it can be built at the same time in the new building in the background.**

tomorrow's business. Nor is "tomorrow" in the distant future for, while the new assembly building has been under construction, a ship with a new record wing span has had to be assembled outdoors (Fig. 1) because the old assembly building was not large enough. This new Martin Ocean Transport, as it is called, is designed to carry 46 passengers, mail and express on 3,500 mile non-stop flights. It has a wing spread of 157 ft. compared with 130 ft. for the China Clippers and it has a gross weight of 63,000 lb. loaded compared with the China Clippers' 52,000 lb.

And what of the future? Mr. Martin and other aircraft designers have stated that the industry is today capable of producing 250,000-lb. flying boats with 300-ft. wing spans capable of carrying 150 passengers on 5,000-mile non-stop flights. They only await the orders. In the meantime, the new Martin assembly building is not only large enough to handle the largest ships of the future but to turn them out in numbers on a mass production basis.

Surprisingly enough it is not the span of existing aircraft buildings that make them inadequate for the large ships but rather it is their lack of sufficient clear height. Thus the Martin China Clippers with 130-ft. wing span but only 91 ft. long were built in the existing assembly building which has only a 125-ft. span but whose clear height was greater than the overall height of the ships. The new super-Clipper of 157-ft. wing span is only 92 ft. long and thus also could have been assembled in the existing building but for its overall height of 27 ft. The new assembly building with its 40-ft. clearance should be ample for anything that will be built during its lifetime. And its ground dimensions make it capable of accommodating ships nearly 300 ft. long which probably means wing spans of 450 ft. In less fanciful language, a half dozen ships bigger than any yet built could be assembled in the new building at the same time.

The building plan

The general layout of the assembly building is shown in Figs. 2 and 3. In addition to the 300x450 ft. clear assembly floor, there is a low two-story wing 40x450 ft. along the west side of the building (Fig. 3) in which all necessary supplemental facilities will be located. Thus in the 18-ft. high first story are located the toilets, locker rooms, first-aid quarters, tool cribs, etc., while the second floor with a 10-ft. ceiling height is devoted half to cafeteria and dining rooms and half to storage for finished parts which will be lowered to the assembly floor by conveyors. A mezzanine in this building accommodates the factory superintendent's office and also additional toilets.

The structural steel framework of the building is enclosed in walls of brick, Gunite and steel sash windows and by an insulated metal roof deck

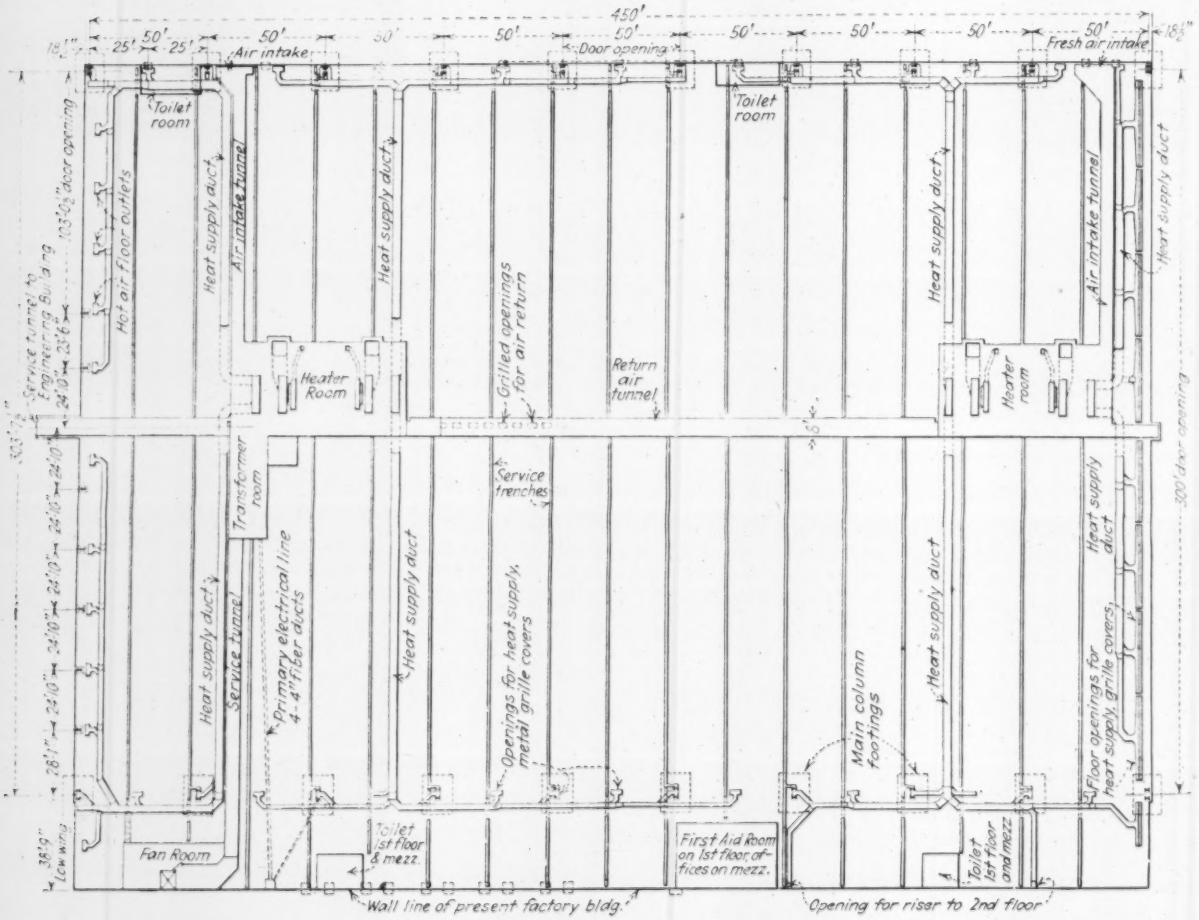


Fig. 2. Plan of new airplane assembly building for Glenn L. Martin Co. at Baltimore showing underfloor tunnels and trenches for heat and utility services.

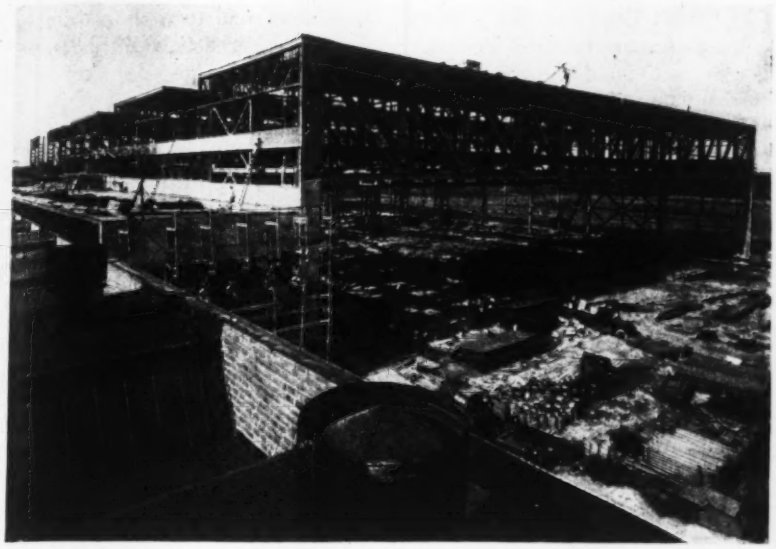


Fig. 3. This 300-ft. opening in the south end of the building will be closed by a novel telescoping-cantilever door. While some workmen apply the metal roof deck and insulation, others below are excavating for the extensive underfloor duct system.

arranged in alternate high and low bays. The bottom 8 ft. of the walls is of brick above which are three 6 ft. 10 in. continuous runs of steel sash separated by 7 ft. 4 in. bands of Gunite; only the lower run of sash contains sections that open. Above the top row of sash is an 11-ft. band of Gunite terminating in a coping flashed with asphalt-protected metal. The roof monitors, 300 ft. long and 66 ft. 8 in. wide, are enclosed in glass sash on all four sides, rising about 13 ft. above the low roof areas. Only the top line of monitor sash is movable; it is motor-operated in long sections, the maximum being 150 ft.

In the south end of the building are three 100-ft. doors of novel telescope-cantilever type which will open to give 40-ft. headroom across the entire 300-ft. opening (Fig. 1). On the north end a single 100-ft. door of the same type is used, giving access to a 75x177 ft. room partitioned off from the assembly floor for experimental work. A door on the east side, 50 ft. wide and 43 ft. high, is of the sliding type.

Lighting

Nearly 60 per cent of the wall area is glass, and in addition the five monitors are completely glass enclosed. Ample natural light is thus assured, and to reduce glare and heat transmission a special blue glass, sandblasted on the inside face, is used on east, west and south exposures of both monitors and walls. This glass, known as Coolite, was adopted after extensive experiments with test panels of various types and thicknesses of special glass installed in the walls of the existing factory. Clear glass is used on the north exposure of the building where glare is less and where the wall will be removed if it is ever necessary to increase the size of the building.

For night work and to supplement the natural light on cloudy days an extensive installation of overhead lights is provided. Whereas the usual modern building seldom exceeds 15 ft.-candles of light on the working plane, 30 ft.-candles will be supplied in the Martin building; and the wiring has a capacity for increasing this to 50 ft.-candles if desired.

Many types of lamps were tested at various heights, resulting in the selection of 750-watt incandescent units hung 2 in. above the bottom chords of the trusses or about 44 ft. above the floor. The lamps, mounted in Alzac reflectors, are spaced 12 ft. apart longitudinally and 16 ft. apart transversely of the building. Thus a total of 750 lamps is required for the 135,000 sq.ft. of floor area.

Underfloor construction

The building is heated by a Leif Lee hot air furnace system. Accommodations for the heating ducts and for the supply lines for electric power, water, gas and compressed air constitute one of the distinguishing characteristics of the layout. These are all located under the floor, a 5-in. 3600-lb. concrete slab reinforced with No. 6 gage wire mesh and surfaced with 2-in. wood block. The locations

Fig. 4. Metal pan forms on top of a service trench ready for the placing of the concrete floor.

of the ducts are indicated on Fig. 2, the heating system occupying one set of concrete trenches or tunnels and the other utilities another set.

A considerable excavation job was required for this construction since several thousand feet of trench was required. Main heat supply ducts are about 4x4½ ft., branch ducts decreasing from this size to 2x2½ ft. The air return tunnel is 8x8 ft. and the power line or service ducts 1½x2 ft. All of these underground structures are in the form of reinforced concrete boxes. Most of them are directly below the floor although the tops of some are as deep as 3 ft.

The heat supply is centered in two underfloor rooms 40x75 ft. in plan and 10 ft. deep located near either end of the building on the longitudinal centerline. A fresh air intake tunnel connects each heater room with grilled openings in the east wall of the building. Four heat supply ducts run from each heater room to the outside walls along which branch ducts with floor outlets at 25 ft. intervals

are located. An exception to this arrangement occurs along the south wall which accommodates the 300-ft. door opening. Here the air outlets are continuous to form a heated air screen against drafts under the doors. All floor outlets are covered with metal grilles so arranged as to discharge the heated air at a flat angle with the floor and equipped with movable louvres to regulate the quantity of air discharged. The heated air moves inward toward the center of the building and is drawn into the return air tunnel on the longitudinal centerline. The grilled floor openings in the top of this tunnel, 2 ft. 9 in. wide by 3 ft. 6 in. long and spaced 6 ft. 3 in. on centers, have a gross area enough larger than the hot air inlets to assure positive flow to them. This is one of the features of the system and is claimed to keep the heated air from rising into the roof where it would do no good. Variation of blower fan speeds also aids in the positive control of air movements.

There are two furnaces in each underfloor room each heated with three oil burners. Air from the combustion chamber of the furnace is drawn over a bank of pipes containing the air to be used in heating the building. Usually this air will consist of 25 per cent fresh air and 75 per cent returned air, although any combination is possible and in the summertime all fresh air can be used, the installation then acting as a ventilation system. The heated air is forced out through the building by a fan. Stack gases from the furnace are carried outside in a metal duct which is located in the fresh air intake tunnel on which it exerts a slight preheating effect.

The service trenches or ducts run transversely of the building and are spaced 25 ft. apart throughout its full length. Since openings occur at 25 ft. intervals in each duct line, a grid of utility outlets 25 ft. apart in each direction is provided. These openings (Fig. 4) are covered with removable covers containing grilles built with special shaped outlets that permit hose lines from the pipes in the trenches to lie flat, thus reducing the size of the obstructions on the floor. The inner ends of the service trenches join the air return tunnel which is made large enough to accommodate the header lines for all the utilities.

Trusses of 303 ft. span

The foregoing description of plant layout and facilities emphasizes continually the controlling desire to keep the assembly floor clear of any obstruction. The expedient most helpful toward this end remains to be described, namely, the adoption of roof trusses spanning the width of the building. Such wide spans are not unique in arched roofs but for the Martin plant a uniform vertical clearance from wall to wall was desired. Therefore, parallel-chord trusses, suggestive of bridge practice, were adopted, and their length of 303 ft. 7½ in. center to center of column supports makes them the longest of their type yet used in building service. In addition to the roof loads, they are designed to support 40,000 lb. crane loads at any one of their quarter points. As a consequence each truss weighs 120 tons, again suggestive of bridge practice.

Ten such trusses are required, spaced 50 ft. apart in the 450 ft. length of the building and supported on columns consisting of two H-section legs joined together on each face by single-angle lacing set at 30 deg. (Fig. 6). The columns at either end of a truss differ both in steel section and in dimensions. The steel section varies because the west line columns have to carry an additional load from the adjacent two-story wing building. The dimensions are not the same because the east line columns are made more slender so that they will bend under truss deflections. All columns are fixed at the base but slotted anchor bolt holes are provided in the east columns so that they can be plumbed under average temperature conditions after the full dead load is on them. It is estimated that they will deflect about 1½ in. either way from the plumb position under truss movements caused by maximum live load and temperature.

Fig. 5. Only about half of the 300x450-ft. unobstructed floor area is shown in this view. In the background is the braced wind bent and at the right the 50x43-ft. sliding door.

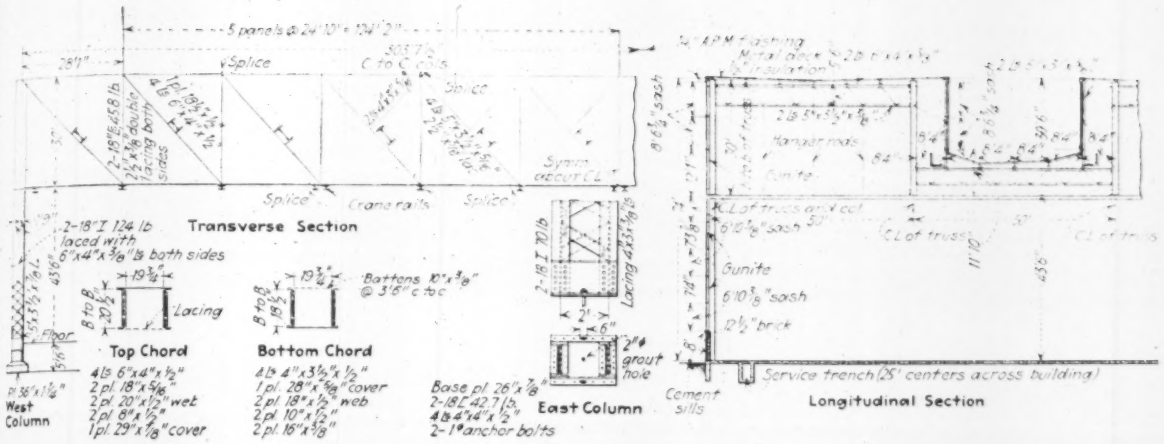


Fig. 6. Details of the structural framing and the 303-ft. parallel-chord trusses that set a new record for building work.

The west columns, designed for a maximum load of 776,000 lb., consist of two 18-in. 124-lb. I-sections spaced 3½ ft. on centers by diagonal lacing of 6x4x⅜ in. angles. In addition, the column legs are reinforced throughout the bottom 12 ft. of their length by four 5x3x½ in. angles. The columns are anchored to the concrete piers by four 3-in. diameter bolts. For the east columns, the design load was 506,000 lb., and the section consists of two 18-in. 70-lb. I's spaced 2 ft. apart by 4x3x⅜ in. angle lacing. These columns are anchored by two 1-in. diameter bolts which pass through slotted holes 6 in. long in the base plates. Since all columns run through to the top of the trusses and extend 5½ ft. below the floor, they are 79½ ft. long.

East-west wind loads are resisted directly by the wall columns. For wind against the north and south walls, however, a special bracing system had to be provided. This is in the form of heavy diagonal bracing between the second and third columns from either end as shown in Fig. 5; operation of the doors precluded installation of this bracing in the end bays. Wind loads are brought to these braced column bays through a heavy horizontal framing system at bottom chord level in the end bays.

The 303-ft. span trusses are 30 ft. deep back to back of angles and are divided into 24-ft. 10-in. panels. All members are built up of plates and shapes, the chords having a box section and the diagonals an I-section while the verticals consist of two double-laced channels. Because of the 40,000-lb. load concentrations on the crane rails which are suspended from the bottom chords, the center six panels of the truss are subdivided by double-angle struts to reduce the effective length of the compression diagonals. The top chord sections are 20½ in. deep and the bottom chords 18½ in. deep; both chords are 19¾ in. wide. The maximum top chord stress is 1348.5 kips compression and the maximum bottom chord stress 1230.6 kips tension. All ten trusses are identical although the two end trusses carry only a half panel roof load. On the south end truss the 300 ft. doors which are suspended from the bottom chord weigh about the same (25 tons) as an extra half panel of roof load while at the north end there is a 100 ft. door to be supported and in addition it is at this end that any future building extension will be made.

Roof framing

Longitudinal bracing between the main trusses is supplied by 50-ft. span trusses which support the roof. In alternate bays these trusses occur at the top and bottom of the main trusses (Fig. 6) thus giving the roof its high-and-low-bay outline.

The high trusses are 5½ ft. deep and the low trusses 4½ ft. deep. Thirteen such longitudinal trusses are used in each bay, one at each panel point of the 303-ft. span trusses. Transverse purlins on the longitudinal trusses are spaced 8 ft. 4 in. apart and carry the insulated metal roof deck. Although the bays between the main trusses are 50 ft. apart, monitor widths are 66 ft. 8 in. This is a result of framing the monitor windows 8 ft. 4 in. outside of the main trusses on vertical truss supports.

Doors of new design

Extensive study and investigation preceded selection of the doors to enclose the 300x40-ft. opening at the south end of the assembly building (Fig. 1). The result was a new type door developed by Paul E. Tignor, field engineer of the company, and detailed and built by the Truscon Steel Co. Briefly, the 300 ft. opening is closed by three 100-ft. wide doors hung from the bottom chord of the truss. Each door is divided along its horizontal centerline into two 20-ft. high units; the exact dimensions are 20 ft. 8 in. for the lower section and 22 ft. 10 in. for the upper. In operation, the lower unit is first raised vertically for its full height, in effect telescoping the upper section. Then the two units together are pulled upward and outward until they lie flat at the bottom chord level, forming a cantilevered canopy outside the building.

The novel element of the design lies in the fact that the lower door section is raised vertically and is completely opened before the upper section starts to move. Several advantages are claimed for this design. In the first place it conserves heat in the building since the 20 ft. opening provided by the telescoping lower sections will suffice for most needs; only occasionally will it be necessary to use the full 40 ft. opening. Another advantage is that maximum visibility from the inside is provided at all times during door openings. A third advantage is that opening of the

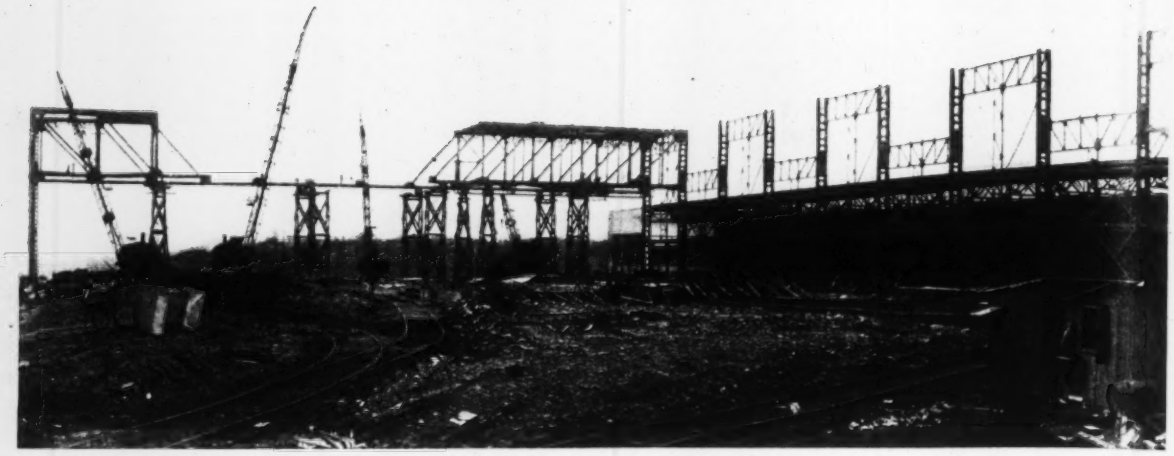


Fig. 7. Erecting the 303-ft. span trusses on timber towers using both locomotive and crawler cranes.

doors does not interfere with cars, tractors or planes which may be parked just outside or inside the doors. These several advantages also promote safety. A 10-hp. electric motor is required to operate each 100-ft. section. Although two separate and distinct operations are required to raise each section to its full height, only one operating mechanism is necessary.

In Fig. 8 the clearance lines required for several types of doors are compared with the telescoping-cantilever door.

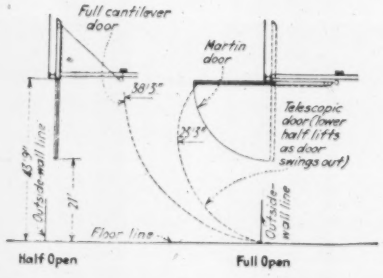


Fig. 8. Martin telescoping - cantilever door and comparative clearance required by other type doors

Erection of the 303-ft. truss bents (Fig. 7) and most of the auxiliary steel was carried out by two locomotive cranes—a 75-ton unit with 110-ft. boom and 20-ft. jib and a 40-ton unit with 86-ft. boom and 20-ft. jib—aided by a 15-ton crawler crane with an 80-ft. boom. Two erection tracks were laid the length of the building on each side of the centerline, one 40 ft. from the wall and one 90 ft., an arrangement that permitted the cranes to cover the entire width of the building. Steel received in gondolas was pushed in on these tracks and unloaded by the locomotive cranes near the point of use.

Erection operations began by setting the heavy columns along the west line, working from north to south. Truss erection began at the south end and moved northward, the east line columns being set up as required. Coincident with these operations, a crawler crane moving from south to north filled in the high-and-low-bay longitudinal roof trusses between the columns and set the steel for the two-story wing building on the west side.

Each main truss was erected on four timber falsework towers placed under panel points, 2 and 5 from either end; two sets of these falsework towers were provided so that the two trusses comprising a single bay could be erected simultaneously. The cranes raised the steel, working from the ends toward the middle.

Both chords came to the job in four sections and each web member was a single erection piece. On each falsework tower the lower chord was supported on two 25-ton journal jacks so that it could be brought to the proper curvature for the 4-19/32-in. camber required at the center.

As stated previously the bases of the columns along the east line were designed with slotted holes so that they could be made plumb after the dead load was on them. However, to eliminate any possibility of bending these columns under such adjustment, the steel erector followed a different procedure. This was first to erect the columns their correct distance apart, namely 303 ft. 7½ in. Then, in erecting the truss, only the top chord column connection was made initially, the bottom chord connection remaining loose. Finally when the truss was completed and swung free so that it deflected from its cambered to its dead-weight outline, the bottom chord connection was made without either bending the columns or sliding them on their bases. The length of the end panels of the bottom chord was adjusted in the shop to make this scheme possible.

The longitudinal trusses for the high and low roof bays which span between pairs of main trusses came to the job in one piece and were also erected by the locomotive cranes. After two trusses and the roof framing between were completed, a gin pole with a small ½-ton hand hoist was mounted on the top chord and, moving from panel point to panel point, placed the monitor frames and all sway bracing and incidental steel.

Personnel

The new plant additions for the Glenn L. Martin Co. were designed by Albert Kahn, Inc., Detroit. C. W. Schmidt, Baltimore, is the general contractor and Bethlehem Steel Co. fabricated and erected the structural steel.

Concrete Improves Its Appearance

From a structural material hidden behind veneers, concrete is developing into an architectural medium that finds application on an increasing number of buildings

AMONG BUILDINGS that express new trends, those which feature the use of architectural concrete are important and growing in number. While the first work with concrete as an architectural medium began some 20 years ago, architects were not attracted to it until about 1925, and only in the past few years has its use become widespread enough to foster development of a successful technique of construction.

To West Coast architects goes the credit for pioneering the application of integral decoration to building walls, but an element of the present trend, in addition to that of improved technique, is the increasing use of architectural concrete in other parts of the country. On the other hand, the new earthquake laws in California have fostered increased use of monolithic walls and frames, and as a consequence architectural concrete structures have continued to multiply there.

Architectural concrete is simply the product of the plastic nature of the material and the forming that can be devised to serve as a container while the material is hardening. Inasmuch as the forming determines line, mass, detail and surface which (granted proper proportioning and placing of the material) determine the architectural appearance of a building wall, proper form construction is at the root of all successful architectural concrete buildings.

Variety in surface textures is supplied by grain marks and joint lines of both unfinished and dressed lumber; by the use of plywood or fiber board form lining to secure smooth surfaces; by washing the concrete face with acid to expose the aggregates; by etching with a sand blast; and by applying stucco-dash coats or heavier hand-troweled and hand-thrown stucco coats. Another type of surface results from bush hammering which reveals the texture of the aggregates without obliterating the form marks.

Shadow lines have been obtained by purposely forcing form boards out of line. In other instances carefully milled beads have been attached to the inside of the forms to produce fluted effects. In still other cases plain surfaces have been provided with V-shaped projections by chamfering the horizontal joints between form boards. For the latter construction it is necessary that the forms be carefully aligned and the joint spacing definitely established so that the projections will be uniformly spaced.

Intricate detail is usually formed in plaster waste molds. Sometimes these are installed in the form and poured with the balance of the wall concrete. In other cases, the details have been precast and set in the form and the concrete poured around them. Various types of grille work have been used, the grilles being both precast and cast-in-place. Careful design is required for such work because the members have a relatively small section, are exposed to the weather on all faces, and must be carefully reinforced. One type of cast-in-place grille is formed by applying the concrete with a gun, shooting from behind against the front form.

For deep rustications, beveled strips have been lightly tacked to the form so that when the forms are removed the strips remain in the concrete and may be removed separately to eliminate breaking of the edges. Plaster waste molds are shellacked so that they will not absorb moisture from the concrete, giving it a light color. Both plaster waste molds and plywood are oiled before concrete is placed in them.

Cement paints have also been used to secure polychrome effects, and in several notable buildings mosaic patterns resulting from the use of varied colored aggregates serve as decorative panels or as complete wall surfaces. Most of the above discussion relates to exterior work where weather resistance is an important factor, but comparable improvements have been made for inside walls, floors and ceilings.

Fig. 1. Decoration on the new Fresno, Calif. auditorium was achieved through the use of plaster waste molds.

SEEN AND HEARD ON BUILDING JOBS

New products and practices of wide application that have aided architects and builders to save time and money

Joining New to Old Steel

Installation of air conditioning equipment in existing buildings invariably requires rearrangement of floorbeams or girders to accomodate the vertical ducts. On such work, Graham, Anderson, Probst & White, Chicago architects, utilize welding to

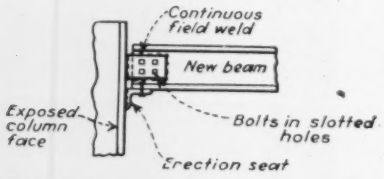


Fig. 1. Weld detail for connecting new beams to existing columns.

join all new to old steel. At columns, for example, only one face has to be exposed for a beam connection; the remainder of the fireproofing and decorative plaster is thus undisturbed. Another advantage is that the enclosure shutting off the alteration work from the rest of the building can adjoin the columns being worked on; if the entire column had to be exposed, the enclosure would have to occupy additional usable office or store space.

According to Magnus Gunderson, chief structural engineer of the firm, an effective detail for connecting new beams to old columns or girders has been developed using two small plates. These are shop bolted to the end of the beam either side of the web. Slotted holes are used so that proper adjustment of span length can be made in the field. On the job a small angle seat is welded to the column as a temporary support for the beam. With the beam set on this seat, the web connection plates are driven forward to firm contact with the column and a weld bead laid down around their entire perimeter. The bolts are removed but the erection seat is left in place. The field operation is speedy and effective, and beams do not have to be cut to exact length. If some side stiffness is required of the connection, angles may be substituted for the web plates.

Water Spray on Skylights

The Plankington Building in Milwaukee is making its air conditioning water do double duty. After passing the cool well water through the air conditioning machinery it is sprayed over the skylights. Although far from cold, the water has not given up all of its coolness and, coupled with the evaporation effect on the warm glass, it noticeably lowers the inside temperature. The water draining from the skylights runs to the city sewers.

Cleaning Air Electrically

The Field Building, Chicago skyscraper, boasts "the cleanest air in the world" as the result of the installation a month ago of a battery of 18 electrostatic precipitators or air cleaners capable of supplying 272,000 cu.ft. of clean air per minute to the first four floors. Instead of removing the dust particles by sifting them out mechanically, the apparatus is designed so that the particles are given an electric charge and then attracted to an oppositely charged plate in a manner similar to that by which a magnet attracts iron filings. The units are claimed to remove 99 per cent, by weight, of all particles in the atmosphere, including those as small as four-millionths of an inch in diameter, such as pollen and tobacco smoke. In a year's time it is estimated that the Field Building installation will have collected about 600 bushels of impurities, 90 per cent of which will consist of particles one-hundredth the diameter of a human hair. By weight, the collection will consist of one-third ash, a third fixed carbon, soot, etc., while the remaining third will be volatile matter such as oils and greases.

Fig. 2. An air-cleaning electric magnet.

A typical cell of one of the units is shown in the accompanying illustration. The air intake consists of the metal tubes, between each pair of which is a fine tungsten wire charged with a 12,000 v. direct current. This d.c. voltage ionizes the air between the wires and the tubes creating an "electrostatic screen" so that all particles of air passing through the screen are electrically charged. Next the air passes into the precipitating chamber in which are mounted a number of closely spaced plates parallel to the air stream. Alternate plates are connected to a ground and to a 5000 d.c. source, setting up a second electrostatic screen between the plates. As the air passes between the parallel plates, this high intensity screen exerts a force on the charged dust particles, drawing them to the grounded plates where they are deposited. The clean air is discharged on the far side. In each cell, such as is illustrated, there are 111 plates, 8x9 in. in size; there are 369 cells. Dust will be removed from the plates every month.

Although the Field Building instal-

lation is the first for office buildings. Westinghouse engineers, who installed it, will soon place similar electrostatic air cleaning units in the chemical laboratories of the Bureau of Standards in Washington. Other uses for the apparatus are in automatic telephone exchanges to prevent dust from collecting on switch contacts, in steel mill furnaces to prevent the nozzles of burners from clogging with foreign matter, and in art galleries to prevent dirt scum from collecting on paintings.

New Field for Bar Trusses

The largest single installation of open bar-web trusses yet made, and perhaps the first use of this type of structural member in the roof framing of a steel mill, is claimed for the new wide strip plant of the Republic Steel Corp. at Cleveland. It is also believed that the buildings of this plant are the first of such structures to be designed by an outside consultant rather than by a steel company's own forces. By designing all flat roofs with bar trusses and a metal deck (both Republic products) and making other incidental revisions, the 14,000 tons of structural steel required for a design made along conventional lines was reduced to 11,400 tons.

Typical framing in each of the several buildings consists of column and truss bents of 105 ft. span spaced 24 ft. apart. The bar truss purlins span the 24 ft. between bents, and in alternate bays frame respectively into the top and bottom chords of the 105 ft. monitor trusses, giving a typical high-and-low-bay roof. Thirteen bar truss purlins are used across each 105 ft. bay. Albert Kahn, Inc., Detroit, designed the building.

Lime Putty For Sale

Lime in putty form for use in mortar, for plaster and for stucco has usually been slaked and aged on the job. Within the past year or two an enterprise has developed which transfers these operations to a central plant from which the product is sold much the same as ready-mixed concrete. The Brooks-Taylor Co. of Birmingham, Ala. originated the idea, and have an arrangement with the Chicago Bridge & Iron Works to fabricate and erect the plants. Among other cities, plants are now in operation in New York, Philadelphia, Wilmington, Washington, Columbia, S. C., Birmingham, Cincinnati, Houston, Pittsburgh, Cleveland, Detroit and Chicago. The plant consists essentially of three elevated steel bins or tanks with conical bottoms. Bulk quicklime received in freight cars or trucks is raised by chain-and-bucket conveyor to the first bin, which has a storage capacity of 17 tons. Beneath this bin is a batch slaker 10 ft. long, 4 ft. wide and 4 ft. deep which will handle about 1 ton of high-calcium quicklime per batch. From the slaker the lime, after passing through a vibrating screen which rejects the core, is dumped into the two aging tanks, each 10½ ft. in diameter and 28 ft. high. Withdrawals are made from these tanks by way of a 1 cu.yd. batcher suspended beneath at a sufficient elevation to clear the delivery trucks.

Speeding Steel Erection

Using a 50-ft. boom fitted with a 15-ft. adjustable cantilever jib extension which carries a second hoisting line, Geo. P. Dysart of Columbus, Ohio, made unusually fast time in erecting steel for the roof of a 75x270-ft. theatre in Columbus. By using the second line of the 9-ton crawler crane boom for handling purlins, bracing members, etc., it was possible to hoist the 2½-ton trusses into position with the main hoisting line and hold them from toppling while the overhang jib was placing the bracing members. The extension jib was able to reach across the top of the trusses which were 43 ft. above ground level.

Fig. 3. While main falls holds truss in position, jib boom line erects purlins and bracing.

Unique Wall 2½ in. Thick

One of the thinnest walls on record for a weatherproof multi-story building is used on the new 5-story warehouse and office structure built by the Westinghouse Electric & Mfg. Co. in Mansfield, Ohio.

Between the lines of continuous window sash at each floor, the wall, which appears as horizontal bands around the three 350 ft. sides of the building, consists of corrugated asbestos-cement sheets (except in the top office story where smooth sheets are used) backed with a 1-in. wood fiber insulation board to the inside of which is bonded a ¼-in. asbestos surfacing.

The total thickness of this unique wall is 2½ in. The insulating value of the wall is high enough that the top story office floor is served satisfactorily with an air-conditioning installation. Prack & Prack of Pittsburgh were the architects.

Innovations in Housing

In laying out the plot plan of the Cedar-Central PWA slum clearance housing project in Cleveland, all buildings located at the corners of the blocks have been set back from the street line so that motor traffic will have a clear view both ways at intersections.

Another innovation is the use of parapet walls extending only 6 in. above the roof. Also on the interior, the arrangement of rooms is such that all columns are concealed either in partitions or in closets. W. R. McCornack of Cleveland is the architect.

Stair Plaster Protection

Frequently concrete stairways are plastered on the soffit of the slab but not on the exposed side of the risers. To eliminate the feather edge of plaster at the sides of the slab, the S. M. Siesel Construction Co., of Milwaukee, builds the stair forms to provide for a bead or rail of concrete at either side of the soffit. This bead protrudes below the soffit plane the thickness of the plaster, and thus forms a side protection for the plaster.

FIG. 1. WELDED FRAME BENTS FOR A SAWTOOTH ROOF FURNISH SOMETHING NEW IN BUILDING SILHOUETTES.

Welded Rigid Frames for Roofs

Two-story all welded factory for Lincoln Electric Company accentuates a trend away from roof trusses by using rigid frames for both sawtooth and arch bents

IN THE DESIGN REVOLUTION that descended on this country's factories a few years ago there was only one element of the industrial building that escaped important change. Walls, roof enclosures, floors, lighting, ventilation and plumbing, all were subjected to development at variance with precedent of long standing. But the roof framing, one of the most prominent items in a building, was overlooked or else successfully resisted radical change. The roof framing in the first factory was a truss and despite introduction of new arrangements of members, it remained a truss for half a century.

Against such a background this article describes a new building for the Lincoln Electric Co. in Cleveland that entirely ignores roof trusses. By substituting welded rigid frames for conventional truss sawtooth roof framing as well as for flat or arched trusses in a wide bay, an entirely new inside appearance is accorded industrial buildings. Other advantages, claimed and demonstrated, lift this structure to a prominent position in any discussion of new trends in building construction.

Providing 200,000 sq.ft. of space and increasing the size of the existing manufacturing facilities by about 75 per cent, the new two-story plant is a product of the Austin Company's design and construction organization. Fundamentally, the feature of the sawtooth roof design is a shop-welded pronged section forming the junction between column and roof beams. Built up entirely of plates, this section is shop-welded to the tops of the supporting columns, the complete unit being called a "tree form" column.

In addition to the section under the sawtooth roof, where bays are 40 ft. wide, the building includes an 80-ft. bay along one side in which the roof framing consists of welded frame arch bents whose apex is 39 ft. above the second floor. The entire building is welded except for the roof purlin connections. It contains 1314 tons of steel.

In ground plan the building is 440 ft. along its north side, 302 ft. on the west and 270 ft. on the south; the east side is curved, concave to the building, to follow a railroad right-of-way.

The first floor throughout is framed in 20 ft. square bays. In the south end, in the 80 x 270-ft. area beneath the lofty second floor, columns are 18-in. 47 lb. H-sections except those in the roof bents which are 24-in. 110-lb. In the remainder or sawtooth section, columns are 18-in. 64-lb. sections. Floor girders throughout are 27-in. 91-lb. sections, while beams framing into these on 7 ft. centers are 18-in. 47-lb. sections. Beam-column connections are made with split I-section seats, supplemented by clip angle web connections on one side only and by split beams at the top flanges on wind bents. Floor to ceil-

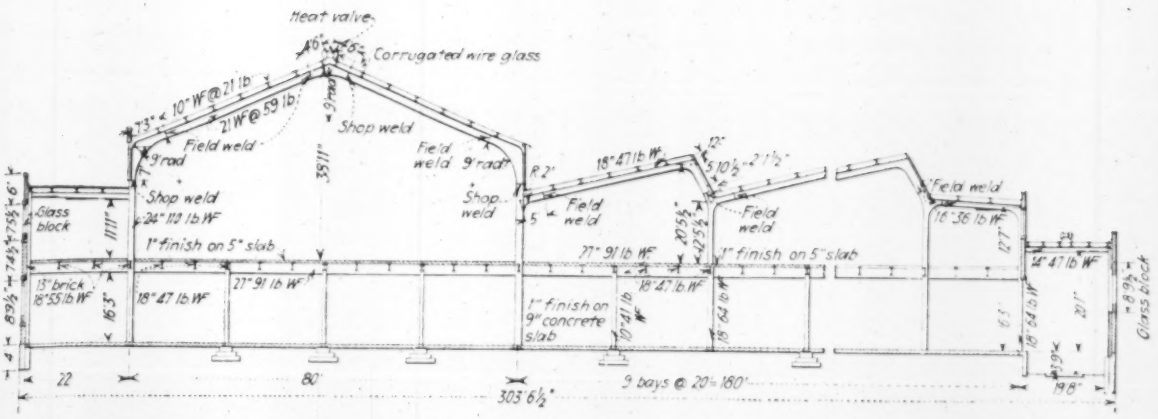


Fig. 2. Section through Lincoln Electric building framing which is distinguished by welded frames for a high arched roof and for a series of sawtooth bays.

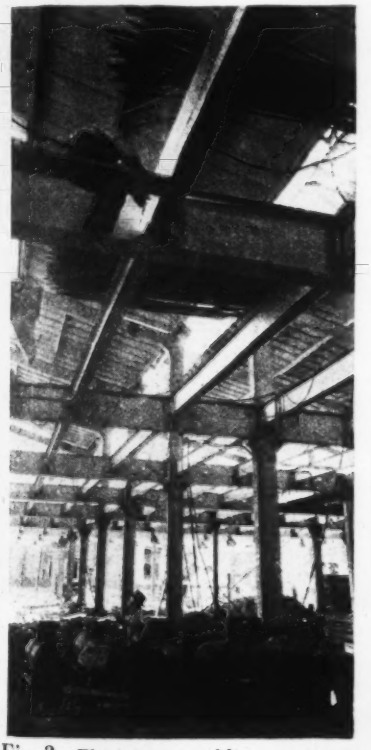


Fig. 3. The six arc-welding generators which supplied current for the operators were kept on the ground floor.

ing, the first floor is 16 ft. 3 in. high. Fig. 2 shows a section of the building.

It is the second floor that is of principal interest from a framing standpoint. In the lofty south bay the bents, in the form of high frames with an 80 ft. span, rise about 65 ft. from the foundations and clear the second floor by 39 ft.; they are spaced 20 ft. apart. The haunch sections, welded to the tops of the columns in the shop, are composed entirely of plates built up into a curved flanged-section by welding.

The top or rafter section of each bent came to the job in two pieces which were welded together at the ridge joint and then lifted into place in one piece. Each of these roof sections consisted of a 21-in. 59-lb. H-section about 65 ft. long, but to one of them the apex or ridge section (built up of welded plates) had been welded in the shop. Joining these two roof sections required one field joint, and two others were required at the column connections. At the latter, temporary cover plates and web angles were used to hold the bent in position until the weld beads could be laid. All field joints are butt welds.

In addition to the purlins, longitudinal bracing between bents consists of three lines of welded lattice beams, one at the apex and one at each haunch. These beams, adopted instead of rolled sections because of their lighter weight, were shop-fabricated using T's for flanges and flats for the Warren webs.

The remainder of the building, covering an area of 80,000 sq.ft., utilizes the welded rigid frame sawtooth roof. The bents, of 40 ft. span, are spaced 20 ft. apart and are arranged in bays varying in length from 240 to 442 ft. In this section the columns are surmounted by the shop-welded prongs. These prongs were entirely plate-fabricated in the shop, the plates, cut and rolled to shape, being first clamped in jigs, then tack welded, and finally finish-welded into an integral section, which was then

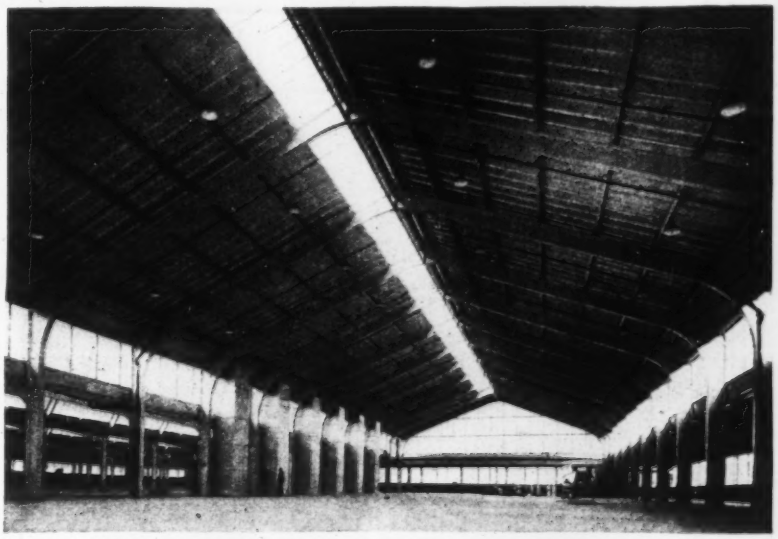


Fig. 4. High arched frames of 80 ft. span support the cement tile roof over a second floor room 240 ft. long. At the ridge, a skylight and a continuous ventilation slot or heat valve supplement the light and exhaust the air admitted through the side wall sash.

Fig. 5. Large erection pieces speeded up field work on the Lincoln plant addition.

welded to the top of the columns.

The roof section of each sawtooth bent is also a single shop-welded section, consisting of one long arm and one short arm, approximately at right angles and composed of 18-in. 47-lb. I-sections. The knee joining these two sections is built up of plates, cut and curved to shape. Field welds at either end of these roof sections connect them to the column prongs.

In erecting the steel, crawler cranes and arc welders were the major equipment items used. Starting at one end of the building, the cranes backed away from the work as each bent was erected. Joints in first floor steel were welded as work progressed, but the connections between roof sections and columns were left bolted until all bents were up and plumbed by means of turnbuckle cables. The closing field joints were then welded and the temporary bolted connection plates removed. The speed of field erection is indicated by the fact that the work was done between July 7 and August 2. In large measure this is held due to the efficiency of the design which required that only 4,600 ft. of the 29,600 ft. of welding had to be done in the field. All welding was done by the Lincoln shielded arc process; a total of 5½ tons of electrodes was used.

Other modern features

Although the special framing is the principal feature of the new Lincoln plant, it is not alone in reflecting the modern design of the layout. For example, the exterior is distinguished by continuous horizontal runs of glass block and sash in the walls, the latter installed to provide air intakes. The sawtooth windows are fixed sash of hammered glass, and continuous heat valves are installed along the ridge lines as well as along the peak of the high arch-frame roof to exhaust the used air from the building. These heat valves or ventilators consist of sliding plates manually operated from the floor by chains.

Wall area not occupied by glass consists of 13 in. of brick except for the use of 8 in. tile in the west wall, which is designed to be removed if and when the plant is expanded. Window sills and lintels are of precast stone. Floors are of concrete.

All roof surfaces are of cement tile, mopped with asphalt and covered with 4-ply roofing. Edge flashing is of metal-covered wood. In the troughs of the sawtooth bays, a cement tile curb carries up 2 ft. to form a sill for the ash. Drainage from the sawtooth valley gutters is led to 5-in. diameter downspout pipes that are carried down the columns inside to a storm sewer under the first floor.

Natural lighting is amply supplied through the large area of glass in walls and roof. It is accentuated by aluminum paint on all interior surfaces and supplemented by 200-watt incandescent lights, four per bay in the areas requiring 20 ft.-candles on the work plane and by 2 lights per bay elsewhere. Electric power for machinery is taken from bus ducts into which outlets may be plugged at will. These ducts are carried on hangers, but all lighting conduit, sprinkler pipes and steam pipes are located above the lower flange of the beams supporting the roof and floor. The result is almost completely unobstructed space.

Designed and built by The Austin Co., Cleveland, this modern plant was delivered to the owners on October 15, or in about 100 working days after instructions were received to proceed with the design.

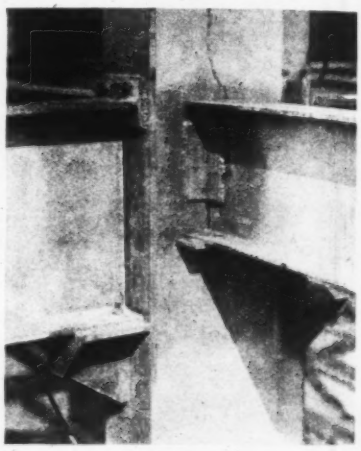


Fig. 6. Typical second floor connections at a column. Split beams are used both for seats and for top flange wind connections.

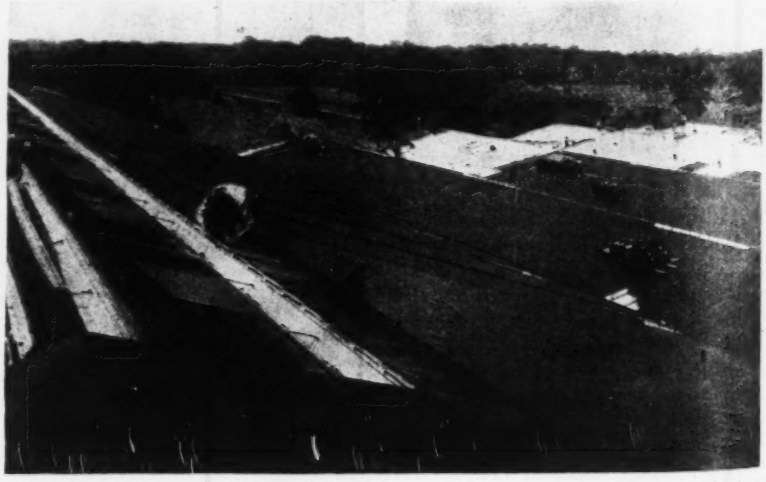


Fig. 7. Applying built-up roof covering to the cement tile deck. Skylight opening and heat valve slit appear at left.

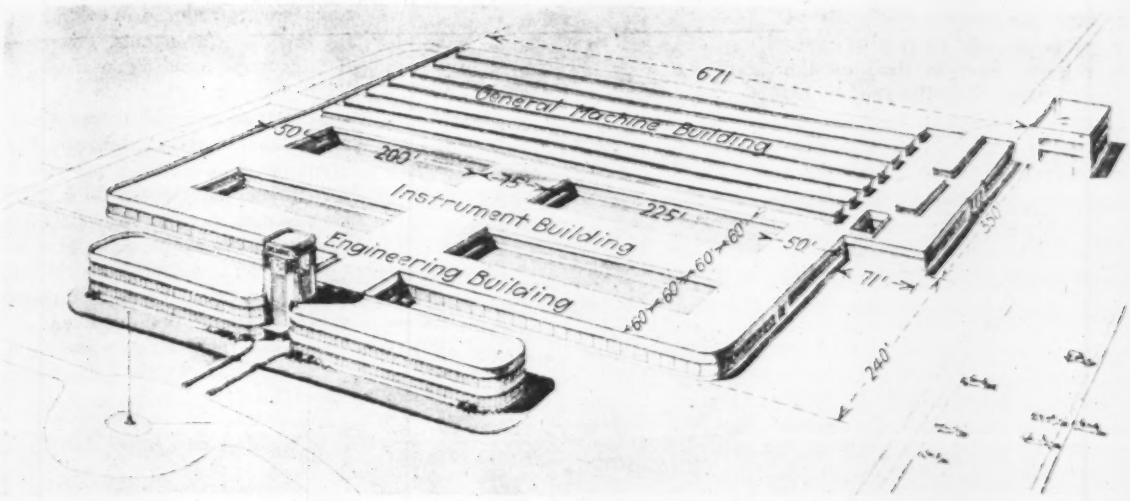


FIG. 1. NEW PLANT OF BENDIX AVIATION CORP. AS IT WILL APPEAR WHEN COMPLETED.

Moving to the Country

Bendix Aviation Corp. builds a 360,000 sq.ft. plant on the New Jersey meadows which is distinguished by welded cantilever roof trusses

A TREND in building development which although not new has nevertheless shown accelerating tendencies during the past year or two involves the moving of industrial plants from congested city areas to the outskirts or even into the country. One of the best current examples of this trend is the new industrial community that Bendix Aviation Corp. is establishing on the New Jersey meadows adjacent to the old Teterboro airport. Planned for 500 employees, the first unit to be built will include a single-story factory and a two-story administration building with gross plan dimensions of 600x700 ft., providing 360,000 sq.ft. of floor space.

A power plant, a foundry, water supply and sewage facilities are also a necessary part of the initial development while housing and other community appurtenances are being considered. Thus, moving to the country involves considerably more than just building an enclosure around some manufacturing machines. The neighborhood surrounding the site, composed of about 25 homes, has changed its name from Teterboro to Bendix, N. J.

The wide open spaces have a natural attraction for companies engaged in manufacturing for the aircraft industry, but Bendix had other good reasons than to be adjacent to the Teterboro airport for locating its new plant in the country. In many respects these reasons when added up explain the general trend to open country sites. Among the reasons are room for expansion, cheaper real estate, unrestricted area to develop large plants under a single roof, better trucking facilities, improved living conditions for employees and clean air and sunlight. Being manufacturers of instruments and other precision accessories, Bendix was particularly in need of clean air free of dust and smoke. Being, in addition, a corporation formed by a consolidation of a number of small scattered companies, it was desirable to bring these together under one roof for economy and efficiency of production. Some of these companies, also, were located in undesirable urban surroundings. The decision to move to the country, therefore, was an easy one.

The choice of a site adjacent to an existing airport followed logically. Located in a relatively fog-free area and near the two largest airplane engine builders, Wright at Paterson, N. J., and Pratt & Whitney at Hartford, Conn., who are important Bendix customers, Teterboro with its mile-long runways provided the company with ideal facilities. Golf courses and residential sections on three sides of the field lend assurance that the surrounding land will not be developed into industrial sites, an important consideration in planning radio and blind-landing test work. The 100-acre factory site is on the fourth side of the airport and is adjacent to both a railroad and a main state highway.

General features of plant

As shown in Fig. 1 the factory, although a single unit about 600 ft. square, is made up of three different buildings. In the rear, the general machine building, 350x671 ft. in plan dimensions, is a monitor-roof struc-

ture whose framing is distinguished by a layout unusual in welded cantilever trusses. Next in line, on the north, is a 60x600 ft. flat roof building for engineering design, and in front of it a similar building for instrument manufacture. These three buildings are separated by 60 ft. wide courts and joined by wings along either side and on the centerline. Finally, joined to this factory by a wing is a two-story administration building, 50x150 ft. in plan, dominated by a central tower 80 ft. high in which radio research will be conducted.

Both the power plant and the foundry buildings were planned to minimize contamination of the air with dust and smoke. Oil will be used for fuel in the power plant, a 50x60 ft. structure placed near the rear of the factory. To provide for factory expansion the foundry, which will produce castings of magnesium, duralumin and other "aviation alloys," was located 1400 ft. from the factory near the south end of the site; it will be a 125x280 ft. building and will be connected by a railroad siding to a 50x150 ft. warehouse. Near the warehouse will be a personnel building containing the hospital and women's locker and dining rooms. Almost all of the buildings will be set about 350 ft. in from the borders of the property, permitting development of parking fields for employees' cars on two sides and a large grassed front yard. One of the entrances to the plant is built as a grade separation on the adjacent state highway.

All factory walls are designed as a continuous band of steel sash placed between base and parapet courses of brick, with sills, lintels and coping of precast concrete. Clear glass is used throughout except for the lower two lights in the engineering and instrument buildings which will be equipped with obscure glass to protect against glare. Floors will consist of a 6-in. concrete slab surfaced with 2-in. wood block except in some portions of the engineering and instrument buildings where asphalt tile will be used. A working clearance of 14 ft. is provided under all roof framing. All roof surfaces will be cement tile covered with 1 in. of insulation and composition roofing. The interior courts will be planted with grass to eliminate dust, and air going into the instrument building will be washed.

The tower which will accommodate

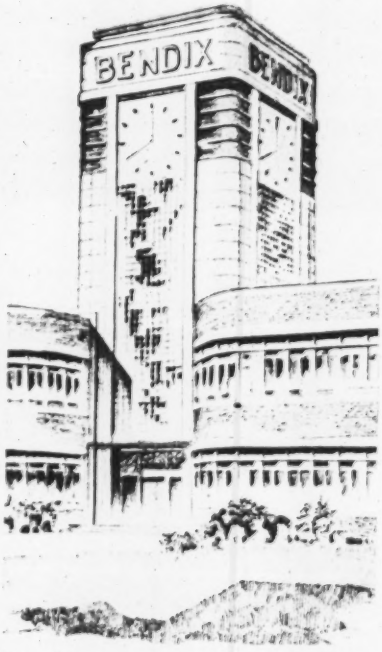


Fig. 2. Executive offices and radio research will be housed in this monumental tower.

the entrance to the administration building has been designed with panels of glass block in each face and curved architectural stone corners. It is equipped with an illuminated clock and an ornamental sign, and will be surmounted by an aviation beacon.

A sewage treatment plant consisting of coarse screens and septic tanks will be built for domestic wastes. Water supply studies are still under way to determine whether deep wells will be driven or whether water will be purchased.

Framing layout

Different requirements in the three buildings composing the factory unit dictated different framing arrangements and size of bays. In the general machine building, where a monitor roof is used, large square bays were desirable, and a 50 ft. spacing of columns in each direction was selected. On the line between this building and the wings connecting to the instrument building this spacing was halved by inserting another column in each bay. The resulting 25 ft. spacing is then maintained on all east-west column lines in the flat roof portion comprising the wings and the instrument and engineering buildings.

On the north-south column lines in these latter two buildings variations were introduced in column spacing to suit requirements. Thus the 60 ft. instrument building consists of two 25 ft. bays on either side of a 10 ft. central trucking and communication bay, while in the engineering building, where open spaces are required for drafting rooms, the 60 ft. dimension is divided into two 30 ft. bays. Finally, in the wings, along the courts, three 20 ft. bays make up the 60 ft. width. By this layout, an unusually simple framing plan resulted which meets the requirements exactly and yet is economical to design, erect and maintain.

Welded cantilever trusses

An important element contributing to the overall efficiency of the framing is the cantilever roof truss layout in the general machine building. By using cantilever trusses, the 50-ft. square bays are framed with 9 lb. of steel per sq.ft. (including bracing and purlins) whereas 10 or 11 lb. is usually required for bays only 30 ft. square when simple trusses are used. A further degree of economy was sought by designing the trusses to be completely welded in the shop.

The truss framing layout is indicated by the sketch in Fig. 3. In both directions a bay containing a truss, made up of a suspended portion and cantilever arms, alternates with a bay containing an anchor truss. Lengthwise of the building, that is, north and south and parallel to the roof monitors, trusses are on the column lines. Transverse to these trusses and supporting the monitors is a series of trusses located on the column lines and at the third points between the columns; these third-point trusses are carried by the main north-south trusses.

All trusses are of Warren type with subdivided panels. They are designed for a total dead load of 29 lb. per sq.ft., a live load consisting of 30 lb. per sq.ft. of snow and wind and a 4000 lb. concentrated load located at any point along the bottom chords. These truss chords are split-beam tees, while web members are double angles. Gusset plates are used only where an extra length of weld is required for stress transfer; elsewhere web members are welded directly to the stems of the chord tees.

All trusses are to be fabricated and erected as 50 ft. spans. The most interesting part of the design involves

the details adopted to make these trusses continuous through the points of support and accomplish the connection between the cantilevers and suspended portions. These structural details are reproduced in Fig. 3.

In the trusses containing the suspended spans, the bottom chords are made continuous, but a 2-in. break, or gap, is provided in the top chord at the ends of the cantilever portion. If soil conditions had warranted a belief that column footing settlement would be equal, this could have been dispensed with and the trusses designed as continuous spans over several supports. In this case, however, the designer felt that uneven settlement was probable and met the condition with bolted, slotted top chord connections at the ends of the cantilevers, thus insuring that unpredicted stresses would not be set up in the structure. The trusses will be shipped and erected with shop bolts in round holes at this joint, but after erection these bolts will be replaced with loose bolts in shop-fabricated horizontal slots, thus forming a definite point of zero moment.

At the column supports the bottom chords of the heavier and deeper north-south trusses frame into column webs, while the top chords are supported on the top chords of the transverse trusses. The bottom chords, to which connection angles are welded in the shop, are milled to bear against the columns; field bolts are used through the connection angles and the column web. A welded erection seat is attached to the column in the shop to carry the vertical load.

A similar bottom chord column connection, without the erection seat, is used for the transverse trusses. At the top chord, however, a large gusset plate engages the top of the column from which the flanges are coped. Finally, for connecting these transverse trusses to the third points of the main trusses, an auxiliary vertical member in the form of a wide plate, slotted to fit over the main truss chord tees, is used to permit connection of gussets on the top and bottom chords of the transverse trusses. With all of these connections made the truss system will virtually be knitted together into a single network.

Present status of work

At present foundations are approaching completion. Erection of steel will start the last of this month.

The Bendix plant was designed by Giffels & Vallet, Inc., architects of Detroit. Robert & Co. of Atlanta acted as consulting engineers, and the Turner Construction Co., New York City, is the general contractor.

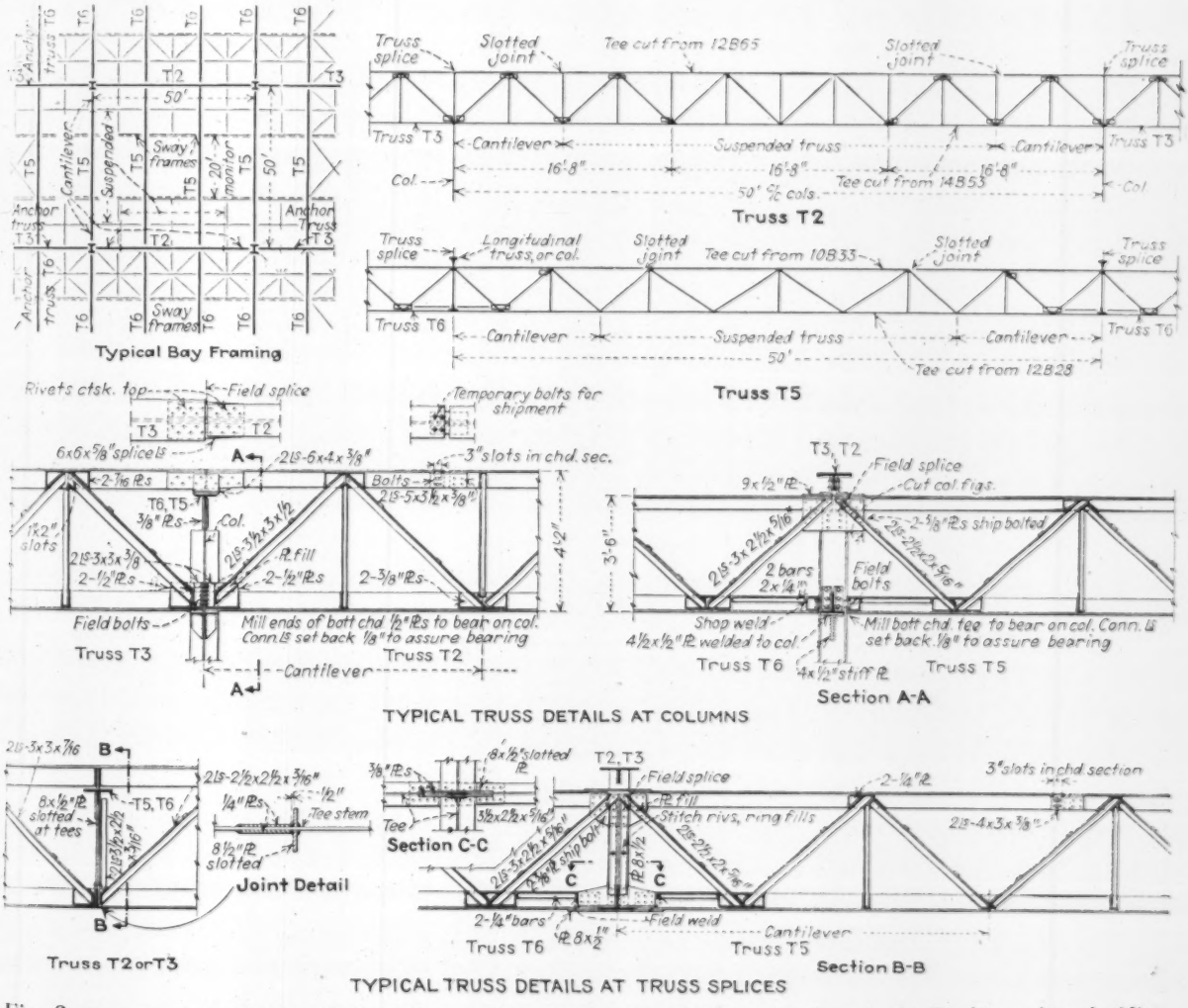


Fig. 3. Layout and details of welded cantilever roof trusses that span 50 ft. square bays in the Bendix machine building.

FIG. 1. BRICK AND CONCRETE EVOLVE INTO A NEW ARCHITECTURAL CONCEPTION OF AN INDUSTRIAL OFFICE BUILDING

Office Building Without Precedent

Johnson Wax building at Racine marks new form of architecture and structural details, new use of materials and unusual construction procedure

WITHOUT PRECEDENT in style of architecture and structural details or in use and arrangement of materials and in construction procedure is the new office home now being built for S. C. Johnson & Son, Inc., wax makers of Racine, Wisc. The building, which is a creation of Frank Lloyd Wright, internationally known architect, marks a leap into the future, for there is little in its conception that bridges the gap between it and the current streamlined treatment of more conventional architecture. Of structural interest are a new form of "morning glory" column—slim, tapering hollow concrete shafts topped by shallow flaring circular caps; a multi-domed flat roof slab; monolithic walls of brick faces on both sides, concrete and cork interior; and exceptional use of expanded metal for concrete reinforcing.

The architect himself sums up the breaking away from all tradition as follows: "Modern architecture usually means something streamlined from the outside—that is, something smoothed flat, all ornament omitted, the corners cut out for window openings, and gas pipe railings put on wherever they will ride. The thought in the building too often does not change from antiquated conventional ideas. Modernity, so called, is achieved as the new look of something old rather than the new look of something new.

"This new Johnson building, on the contrary, is a highly developed synthesis of form and idea—more highly developed than has been possible in the past because it is a building without windowed walls. It consists of a great workroom breathing from above through two nostrils; a building having dignified character and appropriate proportions throughout. This new building is simply and sincerely an interpretation of modern business conditions designed to be inspiring to live in and to work in."

General design

The above philosophy is carried out not only in general plan and arrangement but down to the smallest detail. Even in orientation usual practice is abandoned. The site, bordering on three streets, is in a section of the city where the small store buildings and frame houses are undistinguished architecturally, so the building literally "turns its back" on all this, and the three street elevations are blind walls except for illuminating bands of glass. The building sets back from the sidewalk lines 14 ft. to provide space for flower beds and shrubbery. The back of the building abuts the main street and the front faces the interior of the lot.

The main building is one large workroom 130x210 ft. in plan and 20 ft. high, to house several hundred office employees. Girdling this room on three sides is a mezzanine gallery 18 ft. wide and clearing the first floor by only 7 ft., on which are located the offices of department heads and junior executives. The fourth side of the main room faces a lobby 30 ft. high.

Grouped around the upper portion of the lobby and extending partly over the main room and overhanging the front of the building as a low second story or penthouse are the executive offices arranged in three ellipsoidal masses. Rising from a tunnel below first floor level to high above the penthouse roof are two circular stacks housing the air conditioning plant and ducts; these are what the architect calls "nostrils."

The lobby extends across the front (interior) side of the main building. Next to it is a covered driveway and beyond that a covered parking space

designated as a "carport." Bordering the carport is a low building, extending only part way across the lot, to serve as a garage and service station. The center part of this structure rises two stories to include a fully-enclosed squash court, connected to the executive offices by a covered bridge. The roof of the carport will

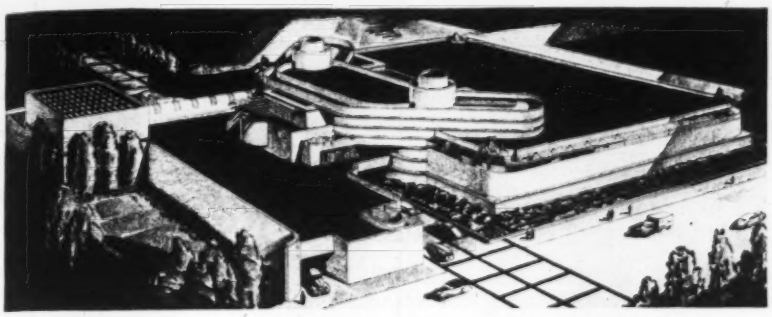


Fig. 2. Blind walls, glass cornices, penthouse of private offices, circular exhaust stacks and a covered parking area are some of the architectural features shown in the architectural sketch. Howe St. is in the foreground.

be a recreational deck.

At mezzanine level, placed between the driveway roof and the overhanging section of the penthouse, is a 350-seat theatre. An architectural feature of the theatre is the ceiling, a series of stepped concentric semi-circular concrete ribs supporting the penthouse overhead. Plan and section of the entire project are shown in Fig. 4.

Though the buildings abut on three streets, the only entrances are through the driveway and thence through the high lobby into the main room. Spiral stairways of exposed stone slabs encircle the two nostrils and provide access to the mezzanine and to the executive offices. A small circular elevator also rises alongside each nostril. Several spiral iron stairways lead from the main floor to the mezzanine in the workroom.

There is no general basement under the building, but a service tunnel runs across the lot, and two long underground corridors serve as rest rooms and lavatories, reached by spiral stairways from the first floor. There are also two underground vault spaces.

Exterior and interior walls, except office partitions, are of special size brick, 3x9x2¼ in., soft red in color. For curved surfaces, of which there are many, the bricks have been molded for both convex and concave planes. Horizontal lines are accentuated by wide horizontal mortar joints raked ½ in. deep, while vertical joints are struck flush with mortar colored to the hue of the brick. The main walls are of brick veneer on both sides, with a 3-in. core of cork; the two spaces between brick and cork are filled with reinforced concrete. Up to mezzanine level the walls are 15 in. thick; above this level they are 11½ in.

At a level 6 ft. above the floor a band of glass—inside and outside horizontal rows of 4-in. glass tubing—encircles the main building. A second set of glass tubes follows the top of the main room as a cornice between wall and roof. The glass tubes will be held by metal ribs or brackets and will be calked for weather tightness. They will provide the natural light, and part of the artificial illumination will be placed between the two rows of tubing. Flat skylights in some of the roof areas will also admit natural light. A somewhat similar treatment of glass bands will be given the penthouse structure. Artificial lighting throughout has been arranged so as to appear to come from the same source as the natural light.

The heating system is an innovation, for the main building floor will act as a radiator, with steam pipes placed under the floor slab. Long diagonal loops of 1¼-in. wrought iron pipes are set in a deep layer of coarse stone spread over the ground, beneath a 3-in. concrete floor slab. The executive offices and other smaller rooms will be heated through the air conditioning system. Steam for heating will be supplied by the nearby factory powerhouse. True air conditioning will prevail throughout the year. A refrigeration system will cool the air in hot weather.

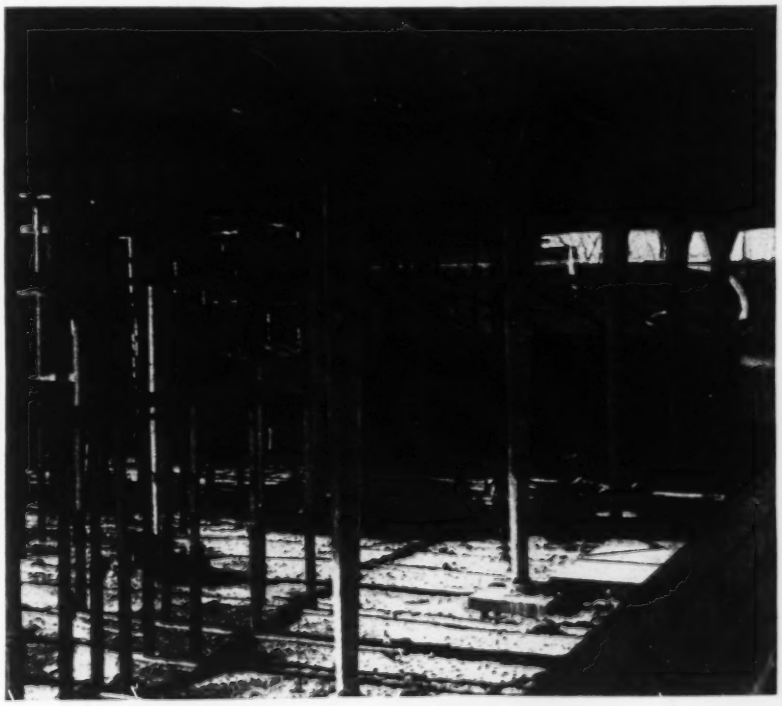
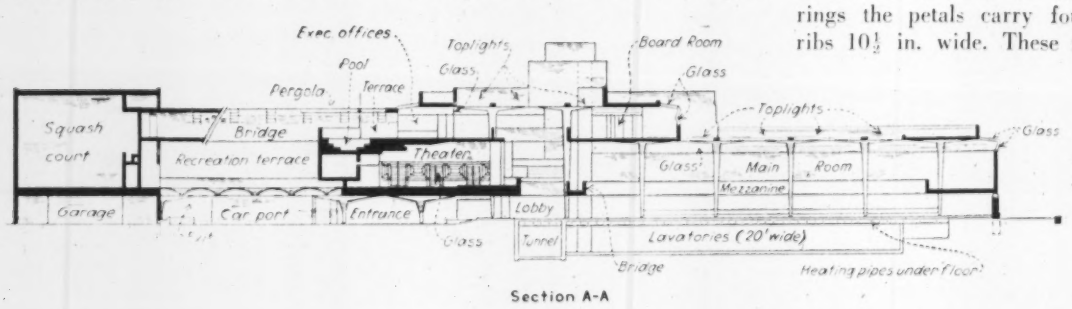


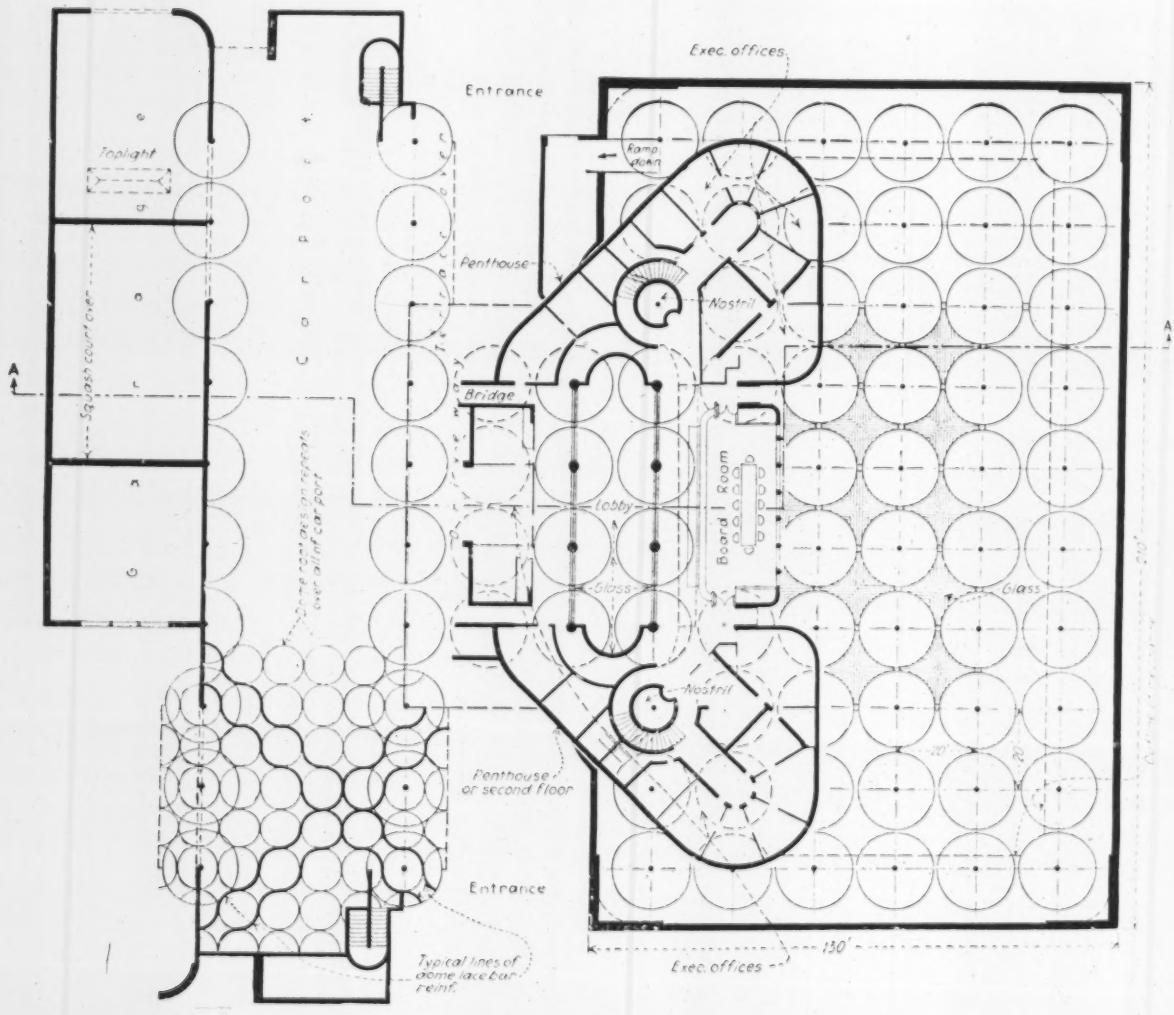
Fig. 3. Morning glory columns—thin, tapering, hollow shafts with a fluted calyx and wide petal cap—are a structural innovation. This is a view of the main workroom during construction.

Engineering interest centers around the design of the concrete columns, which are spaced 20 ft. c. to c. in both directions. These are slender tapering shafts; their 9-in. lower tips rest in an iron socket base set on small spread footings (Fig. 3). The column stems widen out gradually and gracefully up to a fluted calyx and then flare out into a hollow slab petal or cap 18½ ft. in diameter. This motif is carried throughout the column system, though there are some variations in height and other dimensions, as shown in Fig. 5.

The tallest columns, in the lobby area, are 31 ft. high; those in the main building are 21 ft. 7½ in., while the carport columns are only 8½ ft. high. All columns, except the short shafts in the carport, are hollow in the calyx and upper part of the stem; wall thicknesses are 5 in. and 3½ in. respectively. The petal, 18½ ft. in diameter, is made up of a sloping bottom slab 2½ in. thick above which are four concentric concrete rings of various widths. In addition to the circular rings the petals carry four radial ribs 10½ in. wide. These ribs have



Section A-A



General Roof Plan and Second Floor Layout

Fig. 4. Unusual architectural treatment of the buildings is shown by this general plan and section. Note the glass bands in the walls, flat toplights in the roof, arrangement of the penthouse office space and the theatre, and the multiple dome roof over the carport. Howe St. is at bottom, Franklin St. is at top, and 16th St. is at right of the plan.

continuous top steel extending from one petal core across to the core of the adjacent petal. The inside and outside concentric rings have ring rod reinforcement. The only reinforcing in the petal slabs and the column stems is No. 10 expanded metal lath; the mesh for the shafts is welded into a cage set inside the forms.

The outside rim of the petal is wedge shaped to support a 2½-in. concrete slab, filling in the open areas between adjacent column caps. Fine wire mesh is placed over the top of the open petals, and a finish floor or roof slab is poured on top of the structural slab. However, over part of the main roof area the space between column petals is filled with flat glass tubing to admit light, as indicated on Fig. 4.

Regardless of height of column, certain dimensions and proportions remain constant. These are: size of petal, top diameter of calyx, taper of calyx and taper of shaft. In a few instances, such as under the theatre, the shafts have been widened into a pier to provide additional support for heavy loads.

A 4-ft. diameter collar is built into those columns passing through the mezzanine to carry the gallery floor. Columns in the carport are solid, both in petal and stem, and the calyx is much deeper than those on the building columns.

The columns with their peculiar petals are indeterminate structures, and were not designed analytically. Rather, their dimensions were specified by the architect who relied entirely on his judgment, the soundness of which was proved by a load test demanded by the state department of building inspection. A column, built solely for test purposes, was loaded with 60 tons of pig iron and sand, all that could be heaped upon the wide petal. Though the maximum column load in the structure will be 12 tons, the test shaft carried five times this weight without sign of failure.

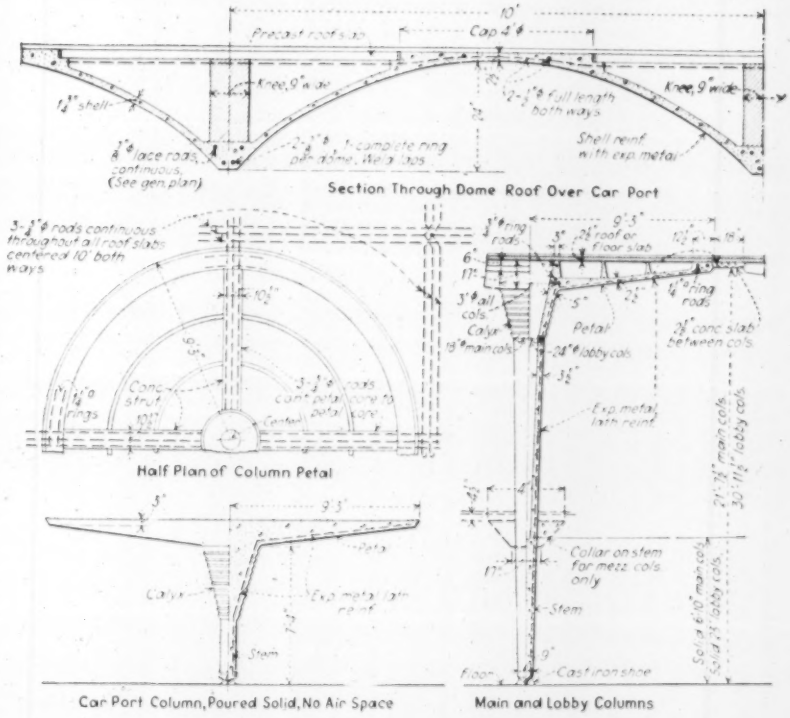

Section Through Dome Roof Over Car Port
Half Plan of Column Petal
Car Port Column, Poured Solid, No Air Space
Main and Lobby Columns
Collar on stem for mezz. cols only
Exp. metal lath reinf.
Cast iron shoe

Fig. 5. New in concrete structures are these morning glory columns, tapering from small bottom tips in iron sockets to wide, flaring, hollow petal caps. Equally unconventional is the multiple dome design of the carport roof slab, as shown in the top detail.

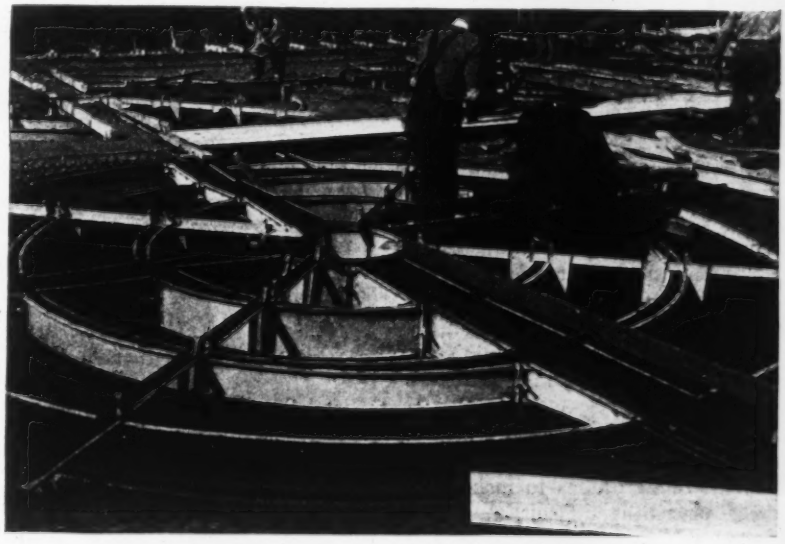


Fig. 6. Complicated metal forms are required for the concentric and radial ribs of the hollow petals topping the columns. Note the expanded metal reinforcing in the petal slab.

Domed roof

Another detail of engineering interest is the roof of the carport. To provide a wide unobstructed area, the carport column layout is two rows of solid petal shafts spaced 20 ft. one way and 50 ft. the other. The smooth top of the petals forms the support of the roof slab, which consists of 10-ft. diameter concrete domes of 1¾-in. shell thickness and a 2-ft. rise. At the base of the domes the shell flares out into a flat slab 6 in. thick which forms the ceiling slab between dome rims. At the top center of each dome is a circular cap 4 ft. in diameter having a shell thickness of 1¾ in. at the dome apex and a maximum thickness of 5 in. at the outside rim. At quarter points, spanning from cap to cap, are concrete knees or struts 9 in. wide, their bottoms resting on the curved shell and the ceiling slab. A precast slab will

Fig. 7. Main walls are monolithic construction of brick, concrete and cork insulation. Interior and exterior surfaces are of the same special deep red brick, molded to the wall curvature.

fit on top of the knees, filling in the space between the circular caps to complete the roof surface which thus will be flat.

Reinforcing of the domes consists of steel ring bars in the bottom rims of the shells, and welded lace or snake bars extending diagonally across the roof, weaving around the rims (see details carport roof in Figs. 4 and 5). Extending through the caps and the tops of the knees are continuous tie bars, lap welded. The dome shells are reinforced with No. 12 expanded metal lath. This novel roof structure will have a minimum span length of 32 ft. and a maximum of 50 ft.

Among other interesting structural details are deep concrete beams, so heavily reinforced as to make concrete placement difficult, cantilever slabs and overhanging beams, and reinforcement consisting of a combination of bars and expanded metal lath.

Construction a slow procedure

Construction has been slow, principally because of the manner in which the architect works; his creative effort is continuous until the structure is complete. Thus the contractor started work with only preliminary plans on hand, and many details are worked out as they are reached. Then, too, many changes are made, all for the better, as work progresses. The owner is in no hurry for the building, being situated in old but comfortable quarters that have served for many years. The owner's attitude—most unusual—is far from that of impatience, but rather is one of delight in watching a new architectural conception evolve into reality.

Work started about a year ago and the building will not be ready for occupancy for another six months at least. As it was impossible to figure exact construction costs in advance the job is being built as a cost-plus contract. Construction operations are different from usual building work; they are more in line with those found on very high class residential construction, requiring few, but highly-skilled, workmen.

All reinforced concrete is made of pea gravel aggregate and 7½ sacks of high-early-strength cement to the cubic yard. A seven-day strength of 3,000 lb. per sq.in. is desired and is being obtained. The concrete batching and mixing plant is located at one of the main entrances. A concrete pump and pipeline system delivers the mix to all parts of the job, though frequently final placement is by wheelbarrow. All concrete is internally vibrated. Foundation and other mass concrete is of standard portland cement and regular size aggregate.

Form building is the chief construction problem. The column shaft and calyx forms are sectional steel units, as are also the petal rib and ring forms and the column cores (Fig. 6). The column petal slab forms are sectional plywood gore panels, supported by adjustable shores. The slabs between petals are also plywood panels carried on shores. Much of the formwork is exceedingly complicated, in which plywood is used profusely.

In building the main walls the inside and outside courses of brick and the cork slab are carried up ahead of the concrete fill (Fig. 7). Mezzanine and parapet walls, faced with brick, require that the brick be built up inside the forms in advance of concrete placement.

Direction

The building is being erected for S. C. Johnson & Son, Inc., by B. E. Wiltscheck, of Racine, who holds the general contract. Mr. Wiltscheck is in direct charge of the work. The plans were prepared in the offices of Frank Lloyd Wright, architect, and he is giving the project his personal supervision. The structure, of some 1,000,000 ft. cubage, will cost in excess of $350,000.

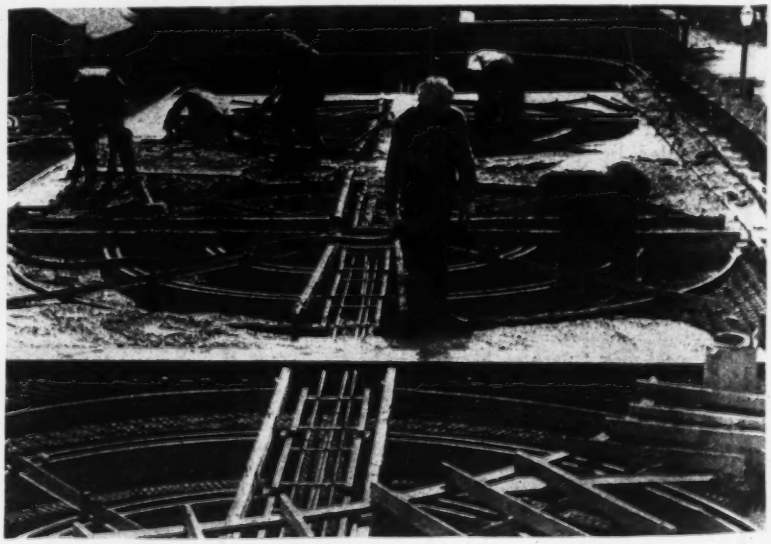


Fig. 8. Placement of concrete in the hollow column petals is a hand job because of the thin bottom slab and narrow circular ribs. The hose held by the man in the foreground leads to the internal type vibrator, hidden in the form.

THE WEEK'S EVENTS

(Continued from page 921)

Research Body Formed For Sand and Gravel

The National Sand and Gravel Association Research Foundation, which will go into operation the first of the year, has been established by a cooperative agreement between the National Sand and Gravel Association and the College of Engineering of the University of Maryland. Testing equipment which is now in the laboratory of the association at Washington will be removed to the university, and the research work started by the association in 1928 will be continued there. Space in the engineering building of the university has been made available and additional space will be provided as required. The university will have the privilege of using much of the association's equipment and the association will use university equipment.

The foundation will be operated by the association, with its activities subject to approval of a joint advisory committee on which the university and the association will have equal representation.

The research committee of the association, of which Alex W. Gann is chairman, has outlined a number of problems to be investigated, and a detailed report will be presented at the forthcoming convention of the association. Among the subjects being given consideration are: adhesion of bitumens to different aggregates; the effect of the shape of aggregates on stability and durability of bituminous mixtures; effect of aggregate characteristics on fatigue of concrete; and a national survey of aggregate characteristics to provide bases of specifications in different localities.

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St. Louis Sues Railroad On Bridge Contract

The city of St. Louis has brought suit against the Terminal Railroad Association for $5,000,000 damages arising from the failure of the association to carry out an agreement made in 1930 to loan the city money for the construction of railroad approaches to the city's municipal bridge. Under the terms of the agreement, the Terminal Association was to loan the money for construction of added railroad approaches which would permit full use of the bridge by the Terminal Association and its proprietary lines. Moreover, according to the city, the association obligated itself to use the bridge sufficiently to assure toll income from the railroad deck of at least $500,000 a year.

The association did advance $1,411,000, but in 1933 it announced that because of the depression it could make no further advances. After some delay, the city obtained funds by means of a bond issue and a federal grant, and is now building the approaches.

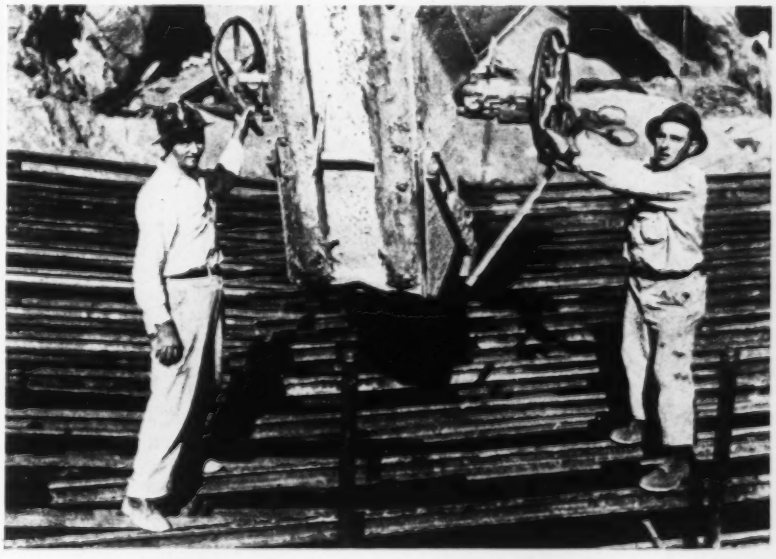
The city bases its claims for damages upon the cost of the bond issue, the loss of tolls arising from the delay in construction, and the extra charges arising from rising construction costs since the time when it was originally planned to build the approaches.

Quebec Names Members To Power Body

The first step toward entry of the provincial government of Quebec into the public utility field is seen in the appointment of S. A. Beaulne, Montreal consulting engineer, and M. J. Savers of Noranda, as members of the National Electricity Syndicate of Quebec.

The National Electricity Syndicate is a body which was set up at the last session of the Quebec legislature and authorized to receive an initial capital from the government of $10,000,000; its operations are confined to the province of Quebec. (*ENR*, May 20, 1937, p. 759).

The syndicate is authorized either to construct its own projects with government funds, following a procedure similar to that of the Ontario hydroelectric system, or to develop a system of joint ownership by the government and by private interests. By this latter plan, the syndicate would act as a stock company and obtain its funds by the sale of stock and debentures.



METROPOLITAN AQUEDUCT MOVES AHEAD

FIRST LOAD of concrete being placed in the Gene Wash dam; concreting started on this dam late in October. The Gene Wash dam is a comparatively small structure 137 ft. high and 423 ft. long on a hill above Parker Dam at the intake of the Metropolitan Water District of Southern California aqueduct. It serves as a reservoir above the first pump lift and as a sump for the second lift.

An interesting feature of this dam, which includes an arch and a gravity section, is the mat of steel rails laid on the foundation and extended up both sides of the canyon. The mat follows the perimeter of the arch section and is designed to prevent cracking of this section from the bottom. It is placed in three staggered layers 9 in. apart, each layer consisting of 40-lb. steel rails 24 in. apart. The rails were taken from tracks used in the construction of the Coachella tunnel of the Metropolitan Aqueduct.

The same type of construction will be used in the nearby Copper Basin dam and the two dams together will require about 40,000 ft. of rail in their construction.

Salt Lake Voters Approve Provo Water Plan

Voters of Salt Lake City on Nov. 22 decided by an overwhelming majority that the Metropolitan water district of Salt Lake City should participate in the Provo River federal reclamation project, thus obtaining for the city an annual water supply of 50,000 acre-ft. The referendum vote also directed the water district to enter into a contract with the federal government for acquisition and construction of an acqueduct to bring water from the Deer Creek reservoir, part of the Provo project, to the city's water lines.

For the past two years the water district has been negotiating a contract with the Provo River Water Users Association. The final decision to participate came when a form of contract was arrived at by which subscriber members of the association may utilize the excess storage capacity in the reservoir for holdover storage of water not used in one season. Since most of the other subscribers are irrigation companies who will use all their water, this provision in the contract gives the city substantial storage rights.

The provo project

The Provo River project includes three units, the Deer Creek reservoir, the Salt Lake Valley aqueduct, and diking of Utah Lake. This latter is not a part of the present program.

The Deer Creek reservoir will be created by an earthfill dam 155 ft. high and 1,400 ft. long at the top. The reservoir will have a storage capacity of 150,000 acre-ft.

There is now no excess flow in the Provo River, so that all water for the reservoir will be brought from the Weber and Duchesne Rivers into the Provo watershed. Water from the Weber River will be brought by enlarging the existing Weber-Provo River diversion canal from its present capacity of 210 sec.-ft. to 1,000 sec.-ft. A 5½-mi. tunnel will bring surplus water from the Duchesne River into the upper Provo.

Present plans for the Salt Lake Valley aqueduct call for a concrete conduit 72 in. in diameter with a capacity of 150 sec.-ft. The conduit will extend from the Deer Creek reservoir dam around the foothills of the Wasatch range for a distance of 40 miles to connect with the existing conduit supplying Salt Lake City.

The estimated cost of the different parts of the project are as follows: Deer Creek reservoir dam, $3,775,000; Weber-Provo diversion canal, $450,000; Duchesne tunnel, $2,082,000. Enlargement of the Provo canal to extend the irrigation features of the project will cost $832,000, bringing the total cost of the Provo project to $7,139,000. Estimated cost of the Salt Lake Valley aqueduct is $5,550,000.

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Three Are Named to Study Reclamation Payments

The membership of a repayment commission which was authorized by the last Congress to devise a more equitable method by which water users on Indian and federal reclamation projects shall repay the cost of construction of irrigation works has been announced by Secretary of the Interior Ickes. Those appointed to the commission are: Dr. Charles A. Lory, chairman, William R. Wallace and George T. Cochran. Dr. Lory has been president of the Colorado State College since 1902. Mr. Wallace, a Utah business man, has for several years been chairman of the Utah Water Storage Commission. Mr. Cochran is an attorney who served for 12 years as state water superintendent of Oregon and is a specialist in water law.

An act passed by the 1937 session of Congress provided for the formation of a commission and authorized it to recommend, after hearings, postponement of all or part of the reclamation payments due in 1937 from those projects where conditions seem to the commission to warrant such action. The commission was further authorized to devise and recommend to the Congress a new and more flexible repayment method and to make a general economic survey of the projects.

Reclamation law requires that water users on federal projects repay the cost of construction without interest within 40 years. The Repayment Commission is not authorized to change this repayment principle but it can recommend changes in the present inflexible method of collection.

During the depression years Congress granted blanket moratoria to all water users on Indian and federal projects, thus postponing repayment installments. Repayments were resumed on a 50 per cent basis in 1936 and on a full basis in 1937, subject to the recommendations of the commission as to particular projects.

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Building Code Out of Print

New York's new building code is out of print. Since publication of our note (*ENR*, Nov. 25, p. 873) to the effect that the code had been printed as the July 9 issue of the *City Record*, we have been advised by the Board of City Record that the July 9 issue is out of print. Preparation of the code in book form is now in process.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Netherland-Plaza Hotel, Cincinnati, Jan. 12-14.

AMERICAN ENGINEERING COUNCIL, annual convention, Washington, D. C., Mayflower Hotel, Jan. 13-15.

SECRETARIES OF ENGINEERING ORGANIZATIONS, annual conference, Washington, D. C., Mayflower Hotel, Jan. 13-15.

AMERICAN ROAD BUILDERS ASSOCIATION, road show and convention, Cleveland, Jan. 17-21.

AMERICAN WOOD PRESERVERS ASSOCIATION, annual meeting, Chicago, Congress Hotel, Jan. 18-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York City, Jan. 19-21.

ENGINEERING INSTITUTE OF CANADA, annual meeting, London, Ont., Jan. 31-Feb. 1.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, annual meeting, Engineering Societies Building, New York City, Feb. 4-18.

REGIONAL AND LOCAL

INDIANA SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, Indianapolis, Ind., Dec. 10.

LOUISIANA ENGINEERING SOCIETY, annual meeting, St. Charles Hotel, New Orleans, Jan. 7-8.

UNIVERSITY OF COLORADO, Highway Engineering Conference, Boulder, Colo., Jan. 13-14.

NEW JERSEY ASSOCIATION OF PROFESSIONAL ENGINEERS AND LAND SURVEYORS, Elks Club, Jersey City, N. J., Jan. 14-15.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, annual meeting, New York City, Jan. 20-22.

NORTH CAROLINA SOCIETY OF ENGINEERS, Raleigh, annual meeting, Raleigh, Jan. 28-29.

SOUTHWEST ROAD SHOW AND SCHOOL, annual session, Wichita Exhibition Building, Wichita, Kan., Feb. 22-25.

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License Examinations

NEW YORK: Examination for professional engineers at New York, Albany, Syracuse and Buffalo, Feb. 1-3. Examination for land surveying, Feb. 4.